TRANSPORTATION PROJECT REPORT

DRAFT DESIGN REPORT / DRAFT ENVIRONMENTAL IMPACT STATEMENT / DRAFT 4(f) EVALUATION

VOLUME 7

Appendix B8 – B11:

B8 – Air Quality Analysis Report
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B11 – Asbestos Assessment

November 2016

PIN 5470.22
NYS Route 198 (Scajaquada Expressway) Corridor
Grant Street Interchange to Parkside Avenue Intersection
City of Buffalo
Erie County

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

ANDREW M. CUOMO
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U.S. Department of Transportation
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APPENDIX B8

Air Quality Analysis Report

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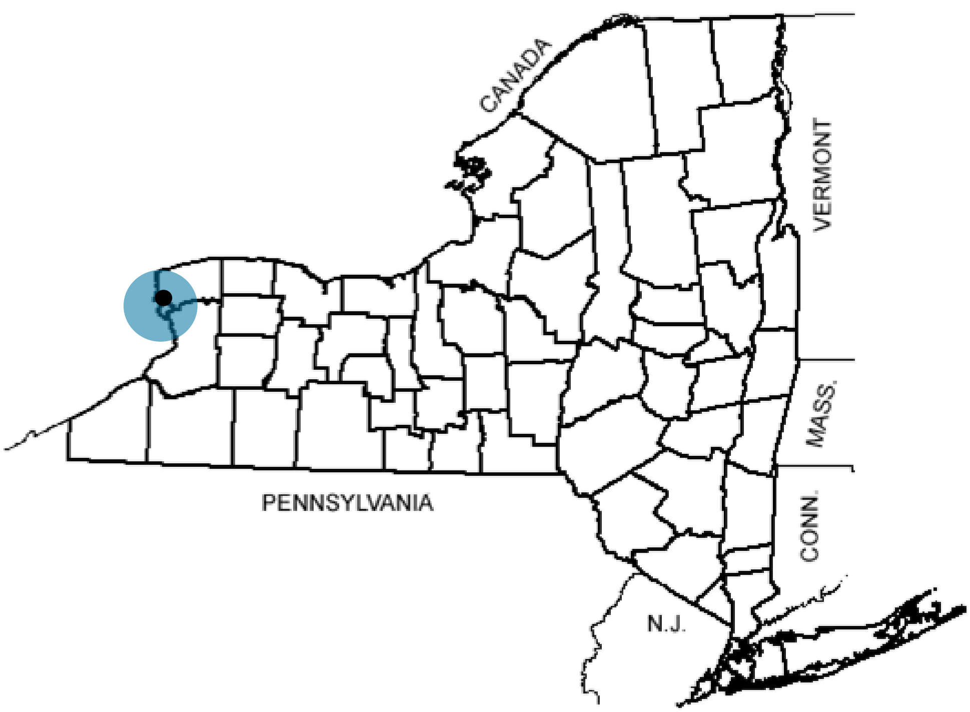

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

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Air Quality Technical Report

NYS Route 198 (Scajaquada Expressway) Corridor

PIN 5470.22
NYS Route 198 (Scajaquada Expressway) Corridor
Grant Street Interchange to Parkside Avenue Intersection
City of Buffalo
Erie County

September 2016

Prepared for:

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

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Abbreviations and Acronyms

AADT...................... annual average daily traffic
ADT .... average daily traffic
ATR .... automatic traffic recorder
BPM........................ best practice model
BTU .... British thermal unit
CO .... carbon monoxide
CO_2e....................... carbon dioxide equivalents
CYA .... critical year analysis
EB........................... eastbound
ETC .... estimated time of completion
GWP....................... global warming potential
LOS .... level of service
MBTU .... Million British Thermal Units
MOVES2014a .... USEPA's MOVES2014a Emission Factor Algorithm
NAAQS................... National Ambient Air Quality Standards
NB .... northbound
NEPA...................... National Environmental Policy Act
NYSDEC .... New York State Department of Environmental Conservation
NYSDOT .... New York State Department of Transportation
$PM_{2.5}$ .... particulate matter with aerodynamic diameters less than or equal to 2.5 microns
PM_{10} .... particulate matter with aerodynamic diameters less than or equal to 10 microns
ppb .... parts per billion
ppm .... parts per million
SB........................... southbound
SEQRA................... State Environmental Quality Review Act
TEM........................ NYSDOT's The Environmental Manual
$\mu g/m^3$.................. micrograms per cubic meter
USEPA .... (United States) Environmental Protection Agency
VMT........................ vehicle miles traveled
WB.......................... westbound

1 Executive Summary

1.1 Introduction

This report provides a description and the results of air quality analyses that were conducted for the Build and No Build Alternatives for the Scajaquada Corridor Project.

In May 2015, the Governor of New York State directed NYSDOT to reduce the posted speed limit along the Scajaquada Expressway from 50 mph to 30 mph. This speed limit change was implemented independent from the current action. However, for the purpose of evaluating cumulative effects, the 50 mph conditions without the proposed project were evaluated.

1.2 Analyses

Mesoscale and localized (microscale) air quality analyses were conducted for the scenarios stated in Section 1.1. This includes mesoscale analyses for criteria pollutants, mobile source air toxics (MSATs), greenhouse gases (GHGs) and energy; microscale analyses for particulate matter smaller than or equal to 10 microns (PM_{10}), and particulate matter smaller than or equal to 2.5 microns ($PM_{2.5}$); and a microscale analysis screening for carbon monoxide (CO).

Following guidance provided in the Air Quality Chapter of the NYSDOT's *Environmental Manual* (TEM), mesoscale analyses were conducted for the project's estimated time of completion (ETC) year (2020), ETC+10 (2030) and ETC+20 (2040).

The microscale PM_{10} and $PM_{2.5}$ analyses were conducted following the procedures contained in the U.S. Environmental Protection Agency (USEPA) *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (USEPA Publication EPA-420-B-15-084, November 2015), as well as other current applicable modeling guidance. USEPA's MOVES2014a emissions model and AERMOD dispersion model were used for the emissions and dispersion modeling.

The CO screening was also performed in accordance with the NYSDOT's TEM. Screening was performed on 39 intersections in the project area.

Particulate matter microscale analyses were conducted for the critical analysis year of 2020, which is the estimated time of completion (ETC) for the project.

The critical analysis year was selected based upon the results of the mesoscale analysis. Dispersion modeling receptor points were placed, in accordance with NYSDOT's TEM and USEPA's modeling guidance, in the residential areas adjacent to the project corridor. Background monitoring data were obtained from appropriate available New York State Department of Environmental Conservation (NYSDEC) monitoring sites. Modeled concentrations, which include appropriate background values, were compared with the applicable National Ambient Air Quality Standards (NAAQS).

1.3 Results

The results of the mesoscale analysis show that, in all analysis years (ETC, ETC+10, ETC+20), emission burdens of VOCs are slightly higher (by 0.1%) under the Build Alternative, when compared to that under the No Build. Emission burdens of NOx, CO, PM_{10} and $PM_{2.5}$ are slightly lower (by -0.1% to -2.2%) under the Build Alternative, when compared to that under the No Build.

In all analysis years, MSATs are slightly lower (by -1.7% to -5.7%) under the Build Alternative, when compared to that under the No Build. In all analysis years, both CO_2e and energy are slightly lower (by -0.4% to -1.3%) under the Build Alternative, when compared to that under the No Build. For all criteria pollutants, MSATs, CO_2e and energy, the highest burdens are in the ETC (2020), and the lowest are in ETC+20 (2040).

The results of the CO screening show that none of the intersections in the project area meet the criteria that would warrant a microscale analysis.

The results of the particulate matter analysis show that no exceedances of the $PM_{2.5}$ or PM_{10} NAAQS are estimated at any of the modeling receptor points under any of the scenarios analyzed.

2 Introduction

This report provides a description and the results of air quality analyses that were conducted for the Build and No Build Alternatives for the Scajaquada Corridor Project.

In May 2015, the Governor of New York State directed NYSDOT to reduce the posted speed limit along the Scajaquada Expressway from 50 mph to 30 mph. This speed limit change was implemented independent from the current action. However, for the purpose of evaluating cumulative effects, the 50 mph conditions without the proposed project were evaluated.

3 Applicable Air Pollutants and Standards

3.1 National Ambient Air Quality Standards and Criteria Pollutants

National Ambient Air Quality Standards (NAAQS) have been established by the U.S. Environmental Protection Agency (USEPA) for the following six major air pollutants: carbon monoxide (CO), nitrogen dioxide, ozone, particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide, and lead. The standards are summarized in Table 1. These pollutants are also known as “criteria” pollutants.

The “primary” standards have been established to protect public health. The “secondary” standards are intended to protect the nation's welfare and account for air pollutant effects on soil, water, visibility, materials, vegetation and other aspects of the general welfare. New York State has adopted these standards (both primary and secondary) as the state standards.

Section 107 of the 1977 Clean Air Act Amendments requires that the USEPA publish a list of all geographic areas in compliance with the NAAQS, plus those not attaining the NAAQS. Areas not in NAAQS compliance are deemed non-attainment areas. Areas that have insufficient data to make a determination are deemed unclassified, and are treated as being attainment areas until proven otherwise. A maintenance area is an area that was previously designated as nonattainment for a particular pollutant, but has since demonstrated compliance with the NAAQS for that pollutant. An area’s designation is based on data collected by the state monitoring network on a pollutant-by-pollutant basis.

Erie County is classified as attainment for all current NAAQS. A brief description of each pollutant is given below.

Table 1 – National Ambient Air Quality Standards

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		Primary	8-hour	9ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead		Primary and secondary	Rolling 3-month average	0.15 µg/m³ (1)	Not to be exceeded
Nitrogen Dioxide		Primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone		Primary and secondary	8-hour	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particulate Matter	$PM_{2.5}$	Primary	Annual	12 µg/m³	annual mean, averaged over 3 years
		Secondary	Annual	15 µg/m³	annual mean, averaged over 3 years
		Primary and secondary	24-hour	35 µg/m³	98th percentile, averaged over 3 years
	PM_{10}	Primary and secondary	24-hour	150 µg/m³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		Primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: USEPA Office of Air and Radiation, http://www3.epa.gov/ttn/naaqs/criteria.html
New York State Department of Environmental Conservation, http://www.dec.ny.gov/chemical/8542.html

Footnotes:

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 year, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O_3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(4) The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2) any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a State Implementation Plan (SIP) call under the previous SO_2 standards (40 CFR 50.4(3)), A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require NAAQS.

3.1.1 Ozone

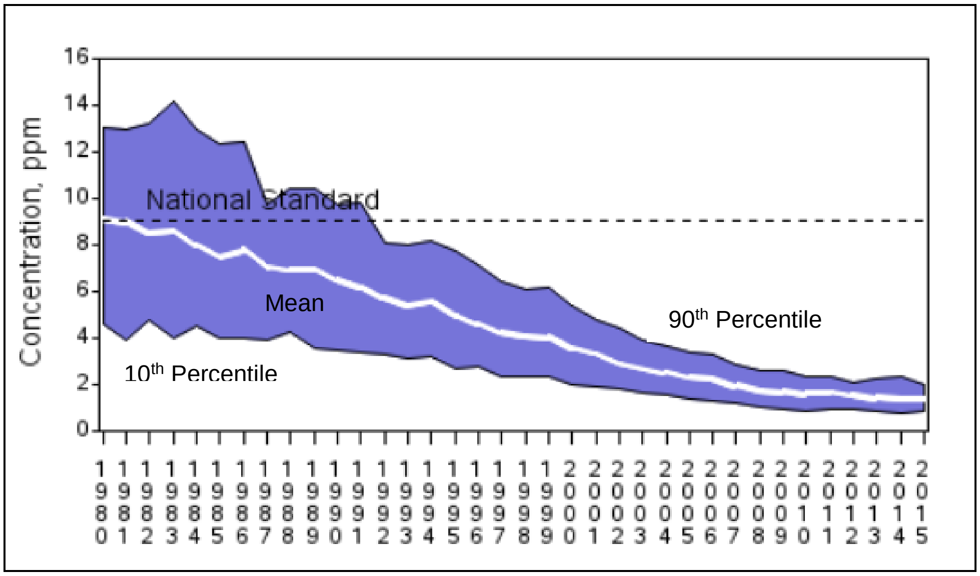
Ozone (O_3) is a colorless toxic gas. O_3 is found in both the Earth's upper and lower atmospheric levels. In the upper atmosphere, O_3 is a naturally occurring gas that helps to prevent the sun's harmful ultraviolet rays from reaching the Earth. In the lower layer of the atmosphere, the formation of O_3 is mostly the result of human activity, although O_3 also occurs because of hydrocarbons released by plants and soil. O_3 is not directly emitted into the atmosphere; in the lower atmosphere, it forms through a series of photochemical reactions in the presence of sunlight, hydrocarbons (HC) (primarily Volatile Organic Compounds or VOCs) and nitrogen oxides (NOx). VOCs and NOx are emitted from industrial sources and from automobiles. Substantial O_3 formations generally require stagnant atmospheric conditions with strong sunlight; thus, high levels of O_3 are generally a concern in the summer. O_3 is the main ingredient of smog. O_3 enters the bloodstream through the respiratory system and interferes with the transfer of oxygen, depriving sensitive tissues in the heart and brain of oxygen. O_3 also damages vegetation by inhibiting its growth.

3.1.2 Carbon Monoxide

Carbon monoxide is a colorless gas that interferes with the transfer of oxygen to the brain. CO is emitted almost exclusively from the incomplete combustion of fossil fuels. Motor vehicle emissions (on-road motor vehicle exhaust) are the primary source of CO. In cities, 85 to 95 percent of all CO emissions may come from motor vehicle exhaust. Prolonged exposure to high levels of CO can cause headaches, drowsiness, loss of equilibrium, or heart disease. CO levels are generally highest in the colder months of the year when temperature inversions (when warmer air traps colder air near the ground) and/or stable atmospheric conditions are more frequent.

CO concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections, along heavily used roadways carrying slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban "street canyon" conditions. Consequently, CO concentrations are predicted on a microscale basis.

As shown in Figure 1, national 8-hour average CO levels have decreased by 85% between 1980 and 2014. This reduction is due in large part to the Clean Air Act. The Clean Air Act required USEPA to issue a series of rules to reduce pollution from vehicle exhaust, refueling emissions and evaporating gasoline. As a result, emissions from a new car purchased today are over 90 percent cleaner than a new vehicle purchased in 1970. This applies to SUVs and pickup trucks, as well. As cleaner vehicles enter the national fleet and older vehicles are taken out of service, emissions continue to drop.

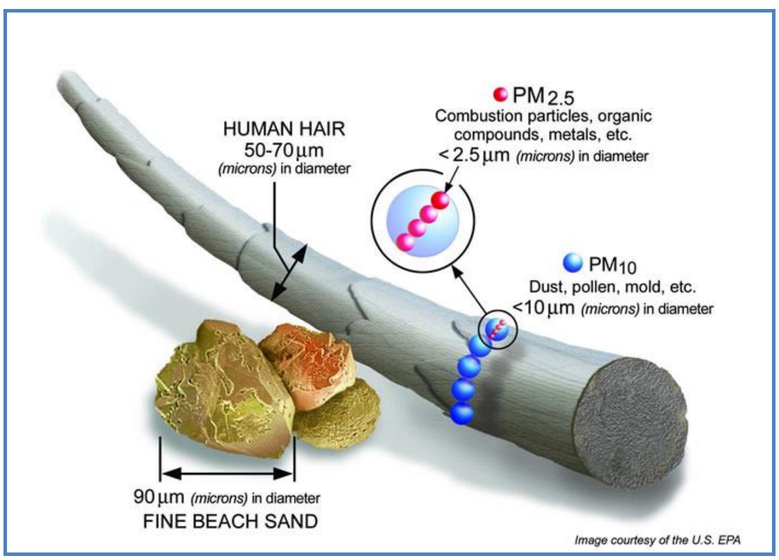


Source: https://www.epa.gov/air-trends/carbon-monoxide-trends#conat

Figure 1 – National 8-Hour Average Carbon Monoxide Levels – 1980-2015

3.1.3 Particulate Matter

Particulate pollution is composed of solid particles or liquid droplets that are small enough to remain suspended in the air. In general, particulate pollution can include dust, soot, salts, acids, metals and smoke; these can be irritating but usually are not poisonous. Particulate pollution also can include bits of solid or liquid substances that can be highly toxic. Of particular concern are those particles that are smaller than, or equal to, 10 microns (PM_{10}) or 2.5 microns ($PM_{2.5}$) in size. A micron, also referred to as a micrometer, is a millionth of a meter. PM_{10} refers to particulate matter less than or equal to 10 microns in diameter, about one-seventh the thickness of a human hair (Figure 2).



Source: USEPA Office of Air and Radiation

Figure 2 – Relative Particulate Matter Size

Major sources of PM_{10} include motor vehicles; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; windblown dust from open lands; and atmospheric chemical and photochemical reactions. Suspended particulates produce haze and reduce visibility. Data collected through numerous nationwide studies indicate that most of the PM_{10} comes from the following:

- Fugitive dust
- Wind erosion
- Agricultural and forestry sources

A small portion of particulate matter is the product of fuel combustion processes. In the case of $PM_{2.5}$, the combustion of fossil fuels accounts for a large portion of this pollutant. The main health effect of airborne particulate matter is on the respiratory system. $PM_{2.5}$ refers to particulates that are 2.5 microns or less in diameter, roughly 1/28th the diameter of a human hair. $PM_{2.5}$ results from fuel combustion (from motor vehicles, power generation, and industrial facilities), residential fireplaces, and wood stoves. In addition, $PM_{2.5}$ can be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds. Like PM_{10}, $PM_{2.5}$ can penetrate the human respiratory system's natural defenses and damage the respiratory tract when inhaled. Whereas particles 2.5 to 10 microns in diameter tend to collect in the upper portion of the respiratory system, particles 2.5 microns or less are so tiny that they can penetrate deeper into the lungs and damage lung tissues. The effects of PM_{10} and $PM_{2.5}$ emissions for the project are examined on the localized, or microscale, and mesoscale bases.

3.1.4 Nitrogen Dioxide

NO_2, a brownish gas, irritates the lungs. It can cause breathing difficulties at high concentrations. Like O_3, NO_2 is not directly emitted, but is formed through a reaction between nitric oxide (NO) and atmospheric oxygen. NO and NO_2 are collectively referred to as nitrogen oxides (NOx) and are major contributors to ozone formation. NO_2 also contributes to the formation of PM_{10}, small liquid and solid particles that are less than 10 microns in diameter (see discussion of PM_{10} below). At atmospheric concentration, NO_2 is only potentially irritating. In high concentrations, the result is a brownish-red cast to the atmosphere and reduced visibility. There is some indication of a relationship between NO_2 and chronic pulmonary fibrosis. Some increase in bronchitis in children (two and three years old) has also been observed at concentrations below 0.3 parts per million (ppm).

3.1.5 Lead

Pb is a stable element that persists and accumulates both in the environment and in animals. Its principal effects in humans are on the blood-forming, nervous, and renal systems. Lead levels in the urban environment from mobile sources have substantially decreased due to the federally mandated switch to lead-free gasoline.

3.1.6 Sulfur Dioxide

SO_2 is a product of high-sulfur fuel combustion. The main sources of SO_2 are coal and oil used in power stations, industry and for domestic heating. Industrial chemical manufacturing is another source of SO_2. SO_2 is an irritant gas that attacks the throat and lungs. It can cause acute respiratory symptoms and diminished ventilator function in children. SO_2 can also yellow plant leaves and erode iron and steel.

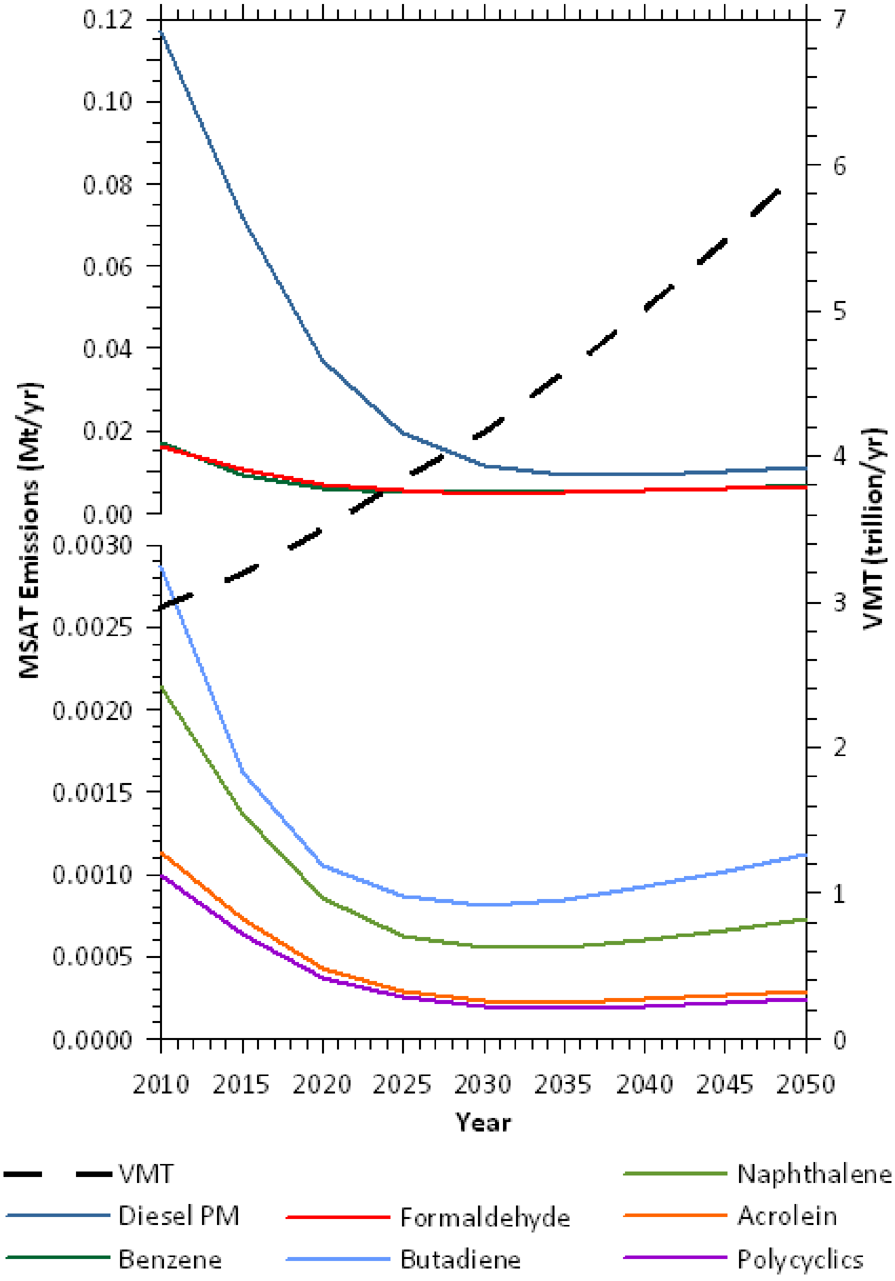
3.2 Mobile Source Air Toxics

In addition to the criteria pollutants for which there are NAAQS, the USEPA also regulates air toxics. Toxic air pollutants are those pollutants known or suspected to cause cancer or other serious health effects. Most air toxics originate from human made sources, including on road mobile sources, nonroad mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries).

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, whereby Congress mandated that the USEPA regulate 188 air toxics, also known as hazardous air pollutants. The USEPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (http://www.epa.gov/ncea/iris/index.html). In addition, USEPA identified seven compounds with substantial contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA) (http://www.epa.gov/ttn/atw/nata1999/). These are: acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter.

The 2007 USEPA rule requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines. According to an FHWA analysis using USEPA's MOVES2010b model, even if vehicle activity (vehicle-miles traveled, VMT) increases by 102 percent as assumed from 2010 to

2050, a combined reduction of 83 percent in the total annual emissions for the priority MSAT is projected for the same period (Figure 3).



Source: Federal Highway Administration's *Interim Guidance Update on Air Toxic Analysis in NEPA Documents* (FHWA, 2012) – EPA MOVES2010b model runs conducted during May–June 2012 by FHWA Note: Trends for specific locations may be different, depending on locally derived information representing vehicle-miles traveled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors

Figure 3 – National MSAT Emission Trends 2010–2050 for Vehicles Operating on Roadways Using EPA's MOVES 2010b Model

3.3 Climate Change and Greenhouse Gases

Climate change is a national and global concern. While the earth has gone through many natural climate variations in its history, there is general agreement that the earth's climate is currently changing at an accelerated rate and will continue to do so for the foreseeable future. Anthropogenic (human-caused) greenhouse gas (GHG) emissions contribute to this rapid change. Carbon dioxide (CO_2) makes up the largest component of these GHG emissions. Other prominent transportation GHGs include methane (CH_4) and nitrous oxide (N_2O).

The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different GHGs. Specifically, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2). The larger the GWP, the more that a given gas warms the earth compared to CO_2 over that time period. The time period usually used for GWPs is 100 years. GWPs provide a common unit of measure, which allows analysts to add up emissions estimates of different gases (e.g., to compile a national GHG inventory), and allows policymakers to compare emissions reduction opportunities across sectors and gases.

- CO_2, by definition, has a GWP of 1 regardless of the time period used, because it is the gas being used as the reference. CO_2 remains in the climate system for a very long time: CO_2 emissions cause increases in atmospheric concentrations of CO_2 that will last thousands of years.
- Methane (CH_4) is estimated to have a GWP of 25 over 100 years. CH_4 emitted today lasts about a decade on average, which is much less time than CO_2. But CH_4 also absorbs much more energy than CO_2. The net effect of the shorter lifetime and higher energy absorption is reflected in the GWP. The CH_4 GWP also accounts for some indirect effects, such as the fact that CH_4 is a precursor to ozone, and ozone is itself a GHG.
- Nitrous Oxide (N_2O) has a GWP 298 times that of CO_2 for a 100-year timescale. N_2O emitted today remains in the atmosphere for more than 100 years, on average.

GHGs are reported in CO_2 Equivalents (CO_2e), which is a combined measure of greenhouse gas emissions weighted according to the global warming potential of each gas, relative to CO_2. CO_2 equivalent is calculated within the MOVES2014a model from CO_2, N_2O and CH_4 mass emissions according to the following equation:

$$\boldsymbol{CO_2e} = CO_2 \times GWP_{CO2} + CH_4 \times GWP_{CH4} + N_2O \times GWP_{N2O}$$

To date, no national standards have been established regarding GHGs, nor has USEPA established criteria or thresholds for ambient GHG emissions pursuant to its authority to establish motor vehicle emission standards for CO_2 under the Clean Air Act. However, the Council on Environmental Quality (CEQ) has released final guidance for Federal agencies on how to consider the impacts of their actions on global climate change in their National Environmental Policy Act (NEPA) reviews. In this guidance, CEQ advises agencies to quantify projected GHGs of proposed Federal actions in Environmental Assessments and Environmental Impact Statements whenever the necessary tools, methodologies, and data inputs are available.

3.4 Energy

Transportation energy use is generally discussed in terms of operational (direct) and construction (indirect) energy consumption. Direct transportation energy is a function of traffic and vehicle characteristics affecting fuel consumption (i.e., volume, speed, distance traveled, vehicle mix, thermal value of the fuel being used for roadway vehicles). Indirect energy consumption consists of the non-recoverable, one-time energy expenditures associated with the construction of the physical infrastructure associated with a project. Energy is commonly measured in terms of British thermal units (Btu). A Btu is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

4 Monitored Pollutant Levels

Monitored data from USEPA and NYSDEC in the Buffalo area are presented in Table 2. No PM_{10} data are available for New York State; as such, the data from the closest active PM_{10} monitor, which is located in Erie, PA are presented. As shown in the table, there were no violations of the NAAQS.

Table 2 – Ambient Air Quality Monitored Data

			Trailer, 185 Dingens St. (Near Weiss St.) Buffalo, NY			**I-90 Mile Post 424.6, EB Side Cheektowaga, NY***		
			2013	**2014**	**2015**	**2013**	**2014**	**2015**
Carbon Monoxide (CO) [ppm]	1-Hour	Maximum	1.9	1.7	2.1		0.7	1.3
		2nd Maximum	1.9	1.6	1.9		0.7	1.2
		# of Exceedances	0	0	0		0	0
	8-Hour	Maximum	1.8	1.3	1.7		0.6	0.9
		2nd Maximum	1.3	1.3	1.5		0.5	0.8
		# of Exceedances	0	0	0		0	0
Particulate Matter [ug/m^3]	PM_{10}	Maximum 24-Hour				37	27	34
		Second Maximum				31	24	32
		# of Exceedances				0	0	0
	$PM_{2.5}$	24-Hour 98th Percentile	20	19	23	17	16	23
		Mean Annual	8	8.8	8.8	7.4	7.4	9.3
Ozone (O_3) [ppm]	8-Hour	First Highest				0.077	0.071	0.076
		Second Highest				0.075	0.070	0.073
		Third Highest				0.073	0.066	0.071
		Fourth Highest				0.071	0.063	0.071
		# of Days Standard Exceeded				1	0	1
Nitrogen Dioxide (NO_2) [ppb]	1-Hour Maximum		52	71	71		46	68
	1-Hour Second Maximum		51	62	62		42	67
	98th Percentile		47	55	53		40	52
	Annual Mean		10.38	8.73	11.1		9.95	12.48
Sulfur Dioxide (SO_2) [ppb]	1-Hour Maximum		10.6	10.1	14.9	23.4	28	39.3
	24-Hour Maximum		5.1	5.4	5.3	8.9	7.7	8.2
	# of Days Standard Exceeded		0	0	0	0	0	0

Notes: Blank cells = pollutant not measured at that location and year. There are no active lead monitors in the region.

*Data for PM_{10} are from 10th & Marne in Erie, PA; Data for O_3 and year 2013 $PM_{2.5}$ are from Audubon Golf Course in Amherst, NY; Data for SO_2 are from 192 Brookside Terrace West in Tonawanda, NY

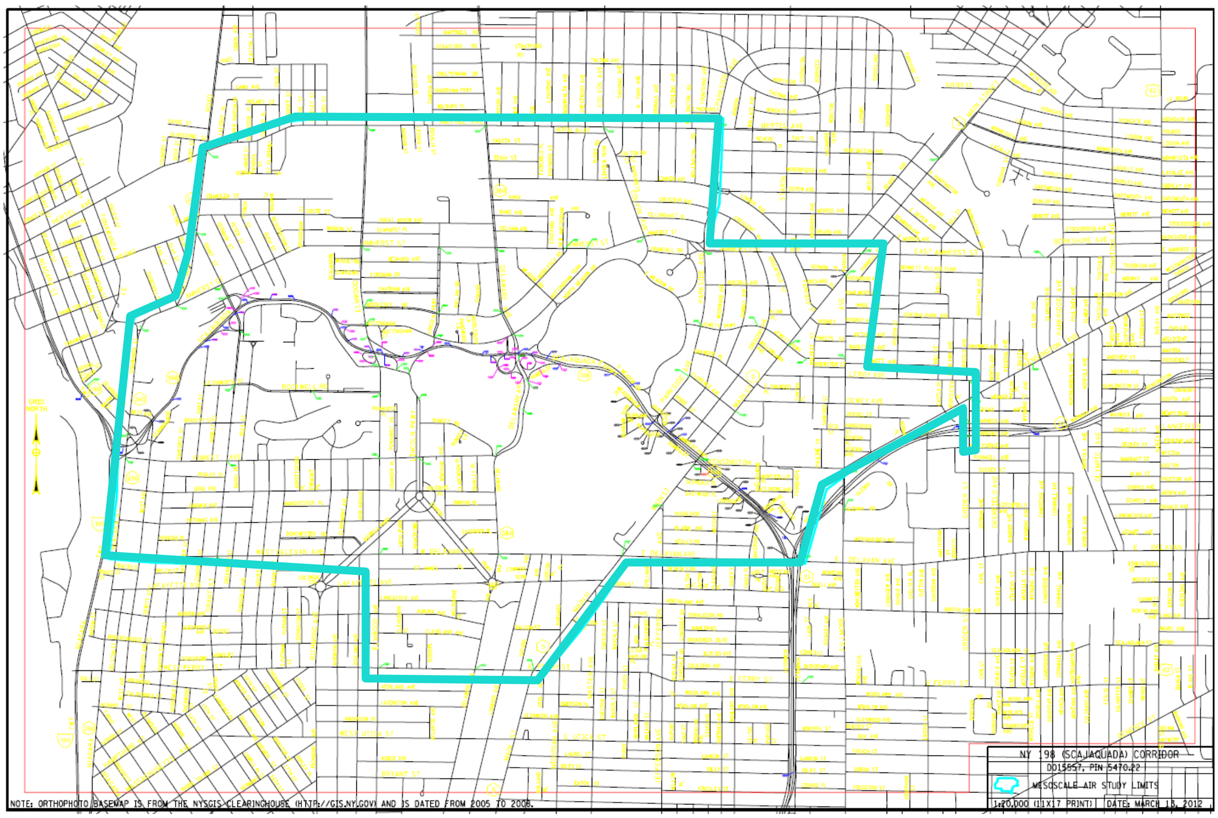
Sources: USEPA AirData, https://www.epa.gov/outdoor-air-quality-data; NYSDEC, http://www.dec.ny.gov/chemical/8536.html

5 Analysis Methodology

5.1 Overview

The air quality study area (study area) encompasses the area within the turquoise polygon shown in Figure 4. Traffic data within the study area were provided on a link-by-link basis for the No Build and Build Alternatives for the years ETC (2020), ETC+10 (2030) and ETC+20 (2040). Traffic data were also provided for the 50 mph conditions without the proposed project.

Figure 4 – Mesoscale Air Quality Study Area



The analysis methodology consisted of the following:

- Define and obtain the traffic data required as input for the mesoscale and microscale analyses, including traffic volumes, traffic mix, and analysis years for study;
- Determine MOVES2014a emission factors for cars and trucks on roads in

the study area for the No Build and Build Alternatives, as well as the 50 mph conditions without the proposed project, for the ETC year, the year of ETC+10, and the year of ETC+20.

- Conduct a mesoscale analysis using full link network, annual average daily traffic (AADT), speeds and vehicle mix information and emission factors from the MOVES2014a model;
- Determine the critical year for the microscale analysis based on results of mesoscale analysis;
- Conduct a CO screening analysis for the study area; and
- Conduct a particulate matter (PM_{10} and $PM_{2.5}$) microscale analysis for the study area.

The air quality analyses were conducted following the procedures contained in the NYSDOT *Environmental Manual* (TEM), updated in December 2012, the USEPA *Using MOVES in Project-Level Carbon Monoxide Analyses* (USEPA 2010) and the USEPA *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (USEPA 2015).

5.2 Traffic

5.2.1 Mesoscale Analysis

The traffic link network used for the mesoscale analysis was based upon the PM peak hour traffic for each alternative and analysis year, on a link-by-link basis. To determine AADT information, a “K” factor of 0.09 was applied to all the links in the network. A “K” factor is the proportion of AADT on a roadway segment or link during a particular hour. A “K” factor was used due to the very limited AADT information available for the project (Traffic technical appendix). Also included in the traffic data were speeds for each link.

5.2.2 CO Screening

The intersection traffic used for the CO screening analysis was based on LOS and volume data in Appendix C, Traffic Information. Table 3 presents the LOS at all 39 intersections screened in the project area.

Per TEM guidance, only those intersections with a Build LOS of D or below have been screened further. As such, the volumes for the 7 intersections with LOS D or below are presented in Table 4.

Table 3 – Overall Intersection LOS

Intersection	No Build						Build					
	AM			PM			AM			PM		
	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)
Grant Street & Amherst Street (Signalized)	C	C	C	C	C	C	C	C	C	C	C	C
Grant Street & WB NYS Route 198 Ramps/ TOPS Plaza (Signalized)	B	B	B	B	B	B	B	B	B	B	B	B
Grant Street & EB NYS Route 198 Ramps/ Buffalo State College (Signalized)	C	C	C	C	C	C	N/A	N/A	N/A	N/A	N/A	N/A
Grant Street & Grant Street Connector/ Buffalo State College (Signalized)	N/A	N/A	N/A	N/A	N/A	N/A	B	B	B	B	B	B
Elmwood Avenue & WB NYS Route 198 Ramps/ Nottingham Terrace (Signalized, except EB right from ramp)	A	A	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A
Elmwood Avenue & Elmwood Avenue Connector/ Nottingham Terrace (Signalized)	N/A	N/A	N/A	N/A	N/A	N/A	C	C	C	B	B	B
Elmwood Avenue & Iroquois Drive (Signalized)	C	C	C	D	D	D	C	C	C	D	D	D
*Iroquois Drive & EB NYS Route 198 Off Ramp (Unsignalized)	C	C	C	C	C	C	N/A	N/A	N/A	N/A	N/A	N/A
*Iroquois Drive & Lincoln Pkwy South (Unsignalized)	C	C	C	C	D	D	N/A	N/A	N/A	N/A	N/A	N/A

Table 3 – Overall Intersection LOS (continued)

Intersection	No Build						Build					
	AM			PM			AM			PM		
	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)
*Nottingham Terrace & Lincoln Parkway North (Unsignalized)	B	B	B	A	A	A	B	B	B	A	A	A
*Nottingham Terrace & WB NYS Route 198 Off Ramp (Unsignalized)	F	F	F	D	D	D	N/A	N/A	N/A	N/A	N/A	N/A
Nottingham Terrace & Delaware Avenue (Signalized)	C	C	D	C	C	D	C	C	C	C	C	C
NYS Route 198 & Parkside Avenue/Medaille Entrance (Signalized)	E	F	F	F	F	F	E	E	E	D	D	E
NYS Route 198 Westbound/Eastbound & Grant Street Connector (Roundabout)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	A	A
NYS Route 198 Westbound & Grant Street Connector (Signalized)	N/A	N/A	N/A	N/A	N/A	N/A	C	C	C	A	A	A
NYS Route 198 & Buffalo State Pedestrian Crossing (Signalized)	N/A	N/A	N/A	N/A	N/A	N/A	B	B	B	A	A	A
NYS Route 198 & Elmwood Avenue Connector (Signalized)	N/A	N/A	N/A	N/A	N/A	N/A	C	C	C	B	B	B
NYS Route 198 & Iroquois Connector Pedestrian Crossing (Signalized)	N/A	N/A	N/A	N/A	N/A	N/A	B	B	B	B	B	B

Table 3 – Overall Intersection LOS (continued)

Intersection	No Build						Build					
	AM			PM			AM			PM		
	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)
*NYS Route 198 & Lincoln Parkway North (Unsignalized)	N/A	N/A	N/A	N/A	N/A	N/A	E	E	F	C	C	C
NYS Route 198 & Delaware Connector (Signalized)	N/A	N/A	N/A	N/A	N/A	N/A	C	C	C	C	C	C
Delaware Avenue & Delaware Connector (Signalized)	N/A	N/A	N/A	N/A	N/A	N/A	B	B	B	C	C	C
NYS Route 198 & Delaware Park Maintenance Driveway (Signalized)	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	A	B	B
Hertel Avenue and Elmwood Avenue (Signalized)	C	C	C	C	C	C	C	C	C	C	C	C
Hertel Avenue and Delaware Avenue (Signalized)	C	C	C	D	D	D	C	C	C	D	D	D
Hertel Avenue and Colvin Avenue (Signalized)	B	B	B	B	C	C	B	B	B	C	C	C
Hertel Avenue and Parkside Avenue (Signalized)	B	B	B	B	B	B	B	B	B	B	B	B
Amherst Street and Elmwood Avenue (Signalized)	B	B	B	C	C	C	C	C	C	C	C	C
Amherst Street and Delaware Avenue (Signalized)	C	C	C	C	C	C	B	B	B	C	C	C
*Amherst Street and Nottingham Terrace (Unsignalized)	D	D	D	F	F	F	D	D	D	F	F	F
Amherst Street and Colvin Avenue (Signalized)	C	C	C	C	C	C	C	C	C	C	C	C

Table 3 – Overall Intersection LOS (continued)

Intersection	No Build						Build					
	AM			PM			AM			PM		
	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)
Amherst Street and Parkside Avenue (Signalized)	C	C	C	C	C	C	C	C	C	C	C	C
Main Street and Amherst Street (Signalized)	C	C	C	C	C	C	C	C	C	C	C	C
*Elmwood Avenue and McKinley H.S. Entrance and Middlesex Road (Unsignalized)	D	D	D	C	C	C	D	D	D	C	C	C
*Middlesex Road and Delaware Avenue (Unsignalized)	C	C	C	C	D	D	C	C	C	C	C	C
Forest Avenue and Elmwood Avenue (Signalized)	B	B	B	C	C	C	B	B	B	C	C	C
Jefferson Avenue and Main Street (Signalized)	B	B	B	B	B	B	B	B	B	B	B	B
Delavan Avenue and Delaware Avenue (Signalized)	D	D	D	D	D	D	D	D	D	D	C	C
Delavan Avenue and Main Street (Signalized)	B	B	B	B	B	B	B	B	B	B	B	B
Kensington Avenue and N. Fillmore Avenue (Signalized)	B	B	B	B	B	B	B	B	B	B	B	B

**For un-signalized intersections, the worst LOS movement was applied.*

Table 4 – Intersection Volumes (LOS D or Worse under Build Conditions)

Intersection	Direction	No Build						Build					
		AM			PM			AM			PM		
		ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)	ETC (2020)	ETC+10 (2030)	ETC+20 (2040)
Elmwood Avenue & Iroquois Drive (Signalized)	EB	39	40	41	141	144	147	39	39	41	139	142	145
	WB	354	364	372	378	387	397	213	219	225	256	263	270
	NB	579	594	609	816	837	857	568	583	596	802	823	843
	SB	843	855	877	793	814	835	838	859	882	812	834	854
NYS Route 198 & Parkside Avenue/Medaille Entrance (Signalized)	EB	1909	1958	1306	1698	1742	1785	1814	1861	1904	1614	1654	1696
	WB	1749	1794	1840	2785	2856	2928	1668	1712	1756	2646	2713	2781
	NB	40	41	43	117	120	124	40	41	43	117	120	124
	SB	1108	1135	1164	516	528	542	1059	1085	1113	492	494	517
*NYS Route 198 & Lincoln Parkway North (Unsignalized)	SB	N/A	N/A	N/A	N/A	N/A	N/A	237	243	249	88	90	93
Hertel Avenue and Delaware Avenue (Signalized)	EB	324	329	333	600	612	618	345	350	356	625	634	643
	WB	525	533	541	490	496	504	540	548	556	518	526	534
	NB	583	591	601	1207	1227	1244	582	590	599	1312	1337	1361
	SB	882	897	910	914	927	942	880	894	897	911	924	939
*Amherst Street and Nottingham Terrace (Unsignalized)	NB	348	353	359	521	529	537	348	353	359	521	529	537
*Elmwood Avenue and McKinley H.S. Entrance and Middlesex Road (Unsignalized)	EB	12	12	12	1	1	1	12	12	12	1	1	1
	WB	11	11	12	13	13	14	11	11	12	13	13	14
	NB	709	727	746	1062	1088	1116	691	708	727	1044	1069	1097
	SB	981	1006	1033	1061	1088	1116	959	984	1011	1037	1063	1090
Delavan Avenue and Delaware Avenue (Signalized)	EB	286	309	313	230	234	237	315	321	326	242	247	251
	WB	501	508	516	801	814	825	521	528	536	821	835	847
	NB	562	571	580	890	902	916	559	568	577	890	902	916
	SB	1254	1272	1292	809	822	835	1262	1280	1300	814	827	839

**Unsignalized intersection*

5.2.3 Particulate Matter Microscale Analysis

In order to process the traffic for the analyses, the traffic volumes were split into the various time periods required for the particulate matter analysis (Table 5).

Table 5 – Traffic Time Periods

Time Period	Abbreviation	Hours Included	Total Hours in Time Period
Morning	AM	6am – 10am	4
Midday	MD	10am – 4pm	6
Afternoon	PM	4pm – 8pm	4
Overnight	ON	8pm – 6am	10

A subset of the mesoscale link network, representative of the analysis location at Parkside Avenue and Scajaquada Expressway (Figure 5), was used for the particulate matter analysis. Traffic volumes were derived for each time period from the PM peak data as described below.

Figure 5 – Particulate Matter Microscale Analysis Study Area – Parkside Avenue and Scajaquada Expressway

AM peak hour data were first derived from PM peak hour data as follows:

- For a 2-way volume, AM = 0.83 * PM volume
- For an EB only volume, AM = 1.3 * PM volume
- For a WB only volume, AM = 0.7 * PM volume

Once AM peak hour data were calculated, the following formulas were applied to derive volumes for each time period:

- Morning = 3.2 * AM volume
- Midday = 2.1 * (AM + PM) volume
- Afternoon = 3.2 * PM volume
- Overnight = 1.0 * (AM + PM) volume

For each roadway segment that was modeled, an associated length and grade were applied. Speeds were applied for each time period. Furthermore, each roadway segment was assigned a roadway type for use in the MOVES2014a modeling.

Unlike the CAL3QHC model, AERMOD does not directly incorporate signal timing at intersections to determine the emissions from vehicular queuing. To account for this link activity, speeds were adjusted for the peak time periods. For the overnight (ON) and midday (MD) periods, the speeds provided for each roadway segment were not adjusted.

For the morning (AM) and afternoon (PM) peak periods, the following adjustments were applied to the speeds to account for queuing:

- NYS Route 198 (Scajaquada Expressway) – speeds reduced by 20 mph
- Parkside Avenue – speeds reduced by 10 mph
- Humboldt Parkway – speed of 20 mph directly applied

Table 6, Table 7, and Table 8 present the roadway characteristics for the particulate matter microscale link network for ETC (2020). As discussed later in this document, ETC (2020) has been determined as the critical year for the particulate matter analysis.

Table 6 – Particulate Matter Microscale Analysis Link Network, 50 mph Conditions Without the Project, ETC

ID	Roadway Segment	MOVES Roadway Type*	Length (mi)	Grade	Volume				Speed (mph)			
					ON	AM	MD	PM	ON	AM	MD	PM
1	Scajaquada, west of Parkside Ave	4	0.026	0	8,531	12,382	17,916	14,918	40	20	40	20
2	Scajaquada, west of Parkside Ave	4	0.054	0	8,531	12,382	17,916	14,918	40	20	40	20
3	Scajaquada, east of Parkside Ave	4	0.022	0	9,869	14,324	20,725	17,258	45	25	45	25
4	Scajaquada, east of Parkside Ave	4	0.013	0	8,513	12,356	17,878	14,886	45	25	45	25
5	Scajaquada, east of Parkside Ave	4	0.038	0	8,513	12,356	17,878	14,886	50	30	50	30
6	Parkside Ave, between Florence Ave and Robie St	5	0.065	0	3,375	4,898	7,086	5,901	35	25	35	25
7	Parkside Ave, between Robie St and Scajaquada	5	0.072	0	3,484	5,057	7,317	6,093	30	20	30	20
8	Parkside Ave, south of Scajaquada	5	0.013	0	445	645	934	778	30	20	30	20
9	Meadowview Pl, west of Agassiz Circle South	5	0.032	0	64	116	135	90	30	20	30	20
10	Agassiz Circle South	5	0.013	0	64	116	135	90	30	20	30	20
11	Agassiz Circle South	5	0.011	0	64	116	135	90	30	20	30	20
12	Agassiz Circle South	5	0.010	0	64	116	135	90	30	20	30	20
13	Humboldt Pkwy EB, east of Agassiz Circle South	5	0.032	0	64	116	135	90	35	20	35	20
14	Humboldt Pkwy EB, east of Agassiz Circle South	5	0.030	0	704	1,273	1,478	979	25	20	25	20
15	Humboldt WB, between Main St and Crescent Ave	5	0.045	0	760	1,001	1,596	1,430	30	20	30	20
16	Humboldt WB, between Crescent Ave and Woodward Ave	5	0.044	0	17	22	36	32	30	20	30	20
17	Humboldt WB, between Woodward Ave and Agassiz Circle North	5	0.018	0	17	22	36	32	30	20	30	20

*Roadway Type: 4 = Urban Restricted; 5 = Urban Unrestricted

Table 7 – Particulate Matter Microscale Analysis Link Network, No Build Alternative, ETC

ID	Roadway Segment	MOVES Roadway Type*	Length (mi)	Grade	Volume				Speed (mph)			
					ON	AM	MD	PM	ON	AM	MD	PM
1	Scajaquada, west of Parkside Ave	4	0.026	0	6,361	9,232	13,358	11,123	30	10	30	10
2	Scajaquada, west of Parkside Ave	4	0.054	0	6,361	9,232	13,358	11,123	30	10	30	10
3	Scajaquada, east of Parkside Ave	4	0.022	0	8,682	12,600	18,231	15,181	35	15	35	15
4	Scajaquada, east of Parkside Ave	4	0.013	0	7,940	11,524	16,675	13,885	35	15	35	15
5	Scajaquada, east of Parkside Ave	4	0.038	0	7,940	11,524	16,675	13,885	40	20	40	20
6	Parkside Ave, between Florence Ave and Robie St	5	0.065	0	3,245	4,709	6,814	5,674	35	25	35	25
7	Parkside Ave, between Robie St and Scajaquada	5	0.072	0	3,245	4,709	6,814	5,674	30	20	30	20
8	Parkside Ave, south of Scajaquada	5	0.013	0	437	635	918	765	30	20	30	20
9	Meadowview Pl, west of Agassiz Circle South	5	0.032	0	0	0	0	0	30	20	30	20
10	Agassiz Circle South	5	0.013	0	0	0	0	0	30	20	30	20
11	Agassiz Circle South	5	0.011	0	0	0	0	0	30	20	30	20
12	Agassiz Circle South	5	0.010	0	0	0	0	0	30	20	30	20
13	Humboldt Pkwy EB, east of Agassiz Circle South	5	0.032	0	0	0	0	0	35	20	35	20
14	Humboldt Pkwy EB, east of Agassiz Circle South	5	0.030	0	488	882	1,024	678	25	20	25	20
15	Humboldt WB, between Main St and Crescent Ave	5	0.036	0	573	755	1,203	1,078	30	20	30	20
16	Humboldt WB, between Crescent Ave and Woodward Ave	5	0.025	0	0	0	0	0	30	20	30	20
17	Humboldt WB, between Woodward Ave and Agassiz Circle North	5	0.015	0	0	0	0	0	30	20	30	20

*Roadway Type: 4 = Urban Restricted; 5 = Urban Unrestricted

Table 8 – Particulate Matter Microscale Analysis Link Network, Build Alternative, ETC

ID	Roadway Segment	MOVES Roadway Type*	Length (mi)	Grade	Volume				Speed (mph)			
					ON	AM	MD	PM	ON	AM	MD	PM
1	Scajaquada, west of Parkside Ave	5	0.026	0	6,326	9,182	13,285	11,062	35	15	35	15
2	Scajaquada, west of Parkside Ave	5	0.054	0	6,326	9,182	13,285	11,062	35	15	35	15
3	Scajaquada, east of Parkside Ave	5	0.022	0	8,251	11,976	17,328	14,429	35	15	35	15
4	Scajaquada, east of Parkside Ave	5	0.013	0	7,547	10,953	15,849	13,197	35	15	35	15
5	Scajaquada, east of Parkside Ave	5	0.038	0	7,547	10,953	15,849	13,197	40	20	40	20
6	Parkside Ave, between Florence Ave and Robie St	5	0.065	0	0	0	0	0	30	20	30	20
7	Parkside Ave, between Robie St and Scajaquada	5	0.072	0	2,805	4,072	5,891	4,906	30	20	30	20
8	Parkside Ave, south of Scajaquada	5	0.013	0	437	635	918	765	20	10	20	10
9	Meadowview Pl, west of Agassiz Circle South	5	0.032	0	0	0	0	0	30	20	30	20
10	Agassiz Circle South	5	0.013	0	0	0	0	0	30	20	30	20
11	Agassiz Circle South	5	0.011	0	0	0	0	0	30	20	30	20
12	Agassiz Circle South	5	0.010	0	0	0	0	0	30	20	30	20
13	Humboldt Pkwy EB, east of Agassiz Circle South	5	0.032	0	0	0	0	0	35	20	35	20
14	Humboldt Pkwy EB, east of Agassiz Circle South	5	0.030	0	467	844	980	650	25	20	25	20
15	Humboldt WB, between Main St and Crescent Ave	5	0.036	0	554	730	1,164	1,043	30	20	30	20
16	Humboldt WB, between Crescent Ave and Woodward Ave	5	0.025	0	0	0	0	0	30	20	30	20
17	Humboldt WB, between Woodward Ave and Agassiz Circle North	5	0.015	0	0	0	0	0	30	20	30	20

*Roadway Type: 4 = Urban Restricted; 5 = Urban Unrestricted

For each roadway segment, a specific mix of vehicles was applied based upon NYSDOT's MOVES vehicle mixes by NYSDOT Region. The NYSDOT Region 5 vehicle mixes (Table 9) were applied to all roadway segments.

Table 9 – NYSDOT Region 5 Vehicle Mix by Roadway Type

Source Type	Urban Restricted	Urban Unrestricted
Motorcycle	0.8%	0.8%
Passenger Car	43.0%	43.5%
Passenger Truck	38.4%	38.9%
Light Commercial Truck	11.3%	11.5%
Intercity Bus	0.3%	0.3%
Transit Bus	0.2%	0.2%
School Bus	0.4%	0.4%
Refuse Truck	0.0%	0.0%
Single Unit Short-Haul Truck	2.7%	2.2%
Single Unit Long-Haul Truck	0.4%	0.3%
Motor Home	0.1%	0.1%
Combination Short-Haul Truck	1.0%	0.8%
Combination Long-Haul Truck	1.2%	1.0%

Note that since the air quality analyses were performed, scope changes were made to the project that resulted in minor changes in traffic data. However, use of the traffic data that were generated after the scope change would not result in changes to the conclusions of the air quality analyses. In addition, the scope change did not change traffic data at the Parkside Avenue intersection, which was the intersection selected for the PM microscale analysis. Thus, revisions to the air quality analyses were not warranted.

5.3 Emission Factor Development

USEPA's emission factor algorithm, MOVES2014a, was used to estimate all the mobile source emission factors for the analyses. MOVES2014a provides great flexibility to capture the influence of time of day, car and bus/truck activity, and seasonal weather effects on emission rates from vehicles. MOVES2014a calculates emission-related parameters, such as total mass emissions and vehicle activity (hours operated and miles travelled). From this output, emission rates (e.g., grams/vehicle-mile for moving vehicles or grams/vehicle-hour for idling vehicles) can be determined for a wide variety of spatial and time scales.

MOVES2014a requires the use of site-specific input data for traffic volumes, vehicle types, fuel parameters, age distribution, as well as other input, as discussed below. By using site-specific data, the emission results reflect the site-specific traffic characteristics of the affected roadways.

MOVES2014a was used to develop the emission factors for both the mesoscale and microscale analyses. Project-specific and Erie County-specific data were imported into MOVES2014a. Erie County-specific data were obtained from the NYSDOT and New York State Department of Environmental Conservation (NYSDEC) for fuel supply and fuel formulation (gasoline and diesel), the vehicle inspection and maintenance program applicable to the area, meteorology, vehicle-age distribution, and alternative fuel vehicle technology availability.

For project-specific vehicle data input, a detailed road-link source network was used in MOVES2014a to capture vehicle volumes (i.e., vehicles per hour/time period), vehicle types (cars, buses/trucks, etc.), speed, and link type (free-flowing or idle) on the affected roadways. A road link/source, as defined in MOVES2014a, describes a defined segment of road or street that has uniform traffic behavior, such as constant volume and speed, that results in a unique emission rate. Typically, one road link/source is used to describe traffic behavior between intersections. Beyond the intersection or another road juncture point where traffic volume, vehicle-type distribution, and/or speed has changed due to vehicles turning off the link/source, other vehicles turning onto the link/source, etc., a different road link/source is used to describe traffic characteristics since the traffic data in that segment may result in a different emission rate.

Emission factors for each free flow road link/source in the study area were determined by dividing calculated emission burdens on each link by miles travelled on each link based on the link's unique project-specific vehicle mix. Idle emission factors (grams/vehicle-hour) were determined by dividing emission burdens for each queue link source by vehicle-hours idling.

Project-specific vehicle volumes (vehicles per hour) were input for each link/source based on traffic data as discussed in Section 5.2. Traffic volumes and vehicle-type distribution per link were based on the traffic study for the project's ETC (2020), the year of ETC+10 (2030), and the year of ETC+20 (2040).

In addition to tail-pipe emissions, vehicle-related emissions of dust (PM_{10} and $PM_{2.5}$) generated by vehicles traveling on paved and/or unpaved roadways were considered for inclusion in this analysis. Road dust emissions of $PM_{2.5}$ are not considered to be a substantial contributor to $PM_{2.5}$ levels in the area. Road dust emissions are considered to be a substantial contributor to PM_{10} levels in the study area, however, and were included in the PM_{10} analysis; this is consistent with recommendations in USEPA's *Transportation Conformity Guidance for Quantitative Hot-spot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas*.

As all roads in the study area are paved, Equation 1 from USEPA's AP42 guidance, Chapter 13.2 – Fugitive Dust from Paved Roads, was utilized. Equation 1 states:

$$E = (k(sL)^{0.91} \times (W)^{1.02})$$

Where:

E = Particulate emission factor in terms of k units
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (grams per square meter)
W = Average weight (tons) of the vehicles traveling the road.

Table 10 highlights values used in Equation 1 to calculate re-entrained PM_{10} emission rates along paved roads.

Table 10 – Re-entrained Road Dust Parameters

Variable	Value	Roads	Source
k	1 gram/VMT	all	AP42 Table 13.2.1-1
sL	0.015 grams/m^2	>10,000 ADT, limited access	AP42 Table 13.2.1-2
	0.06 grams/m^2	5,000 – 10,000 ADT	AP42 Table 13.2.1-2
Winter Correction	1x	All >10,000	AP42 Table 13.2.1-2
	2x	All between 5,000 – 10,000	AP42 Table 13.2.1-2
Weight	4 tons	All roads except HOV lanes during peak periods	Project-specific
	3 tons	HOV lanes during peak periods	Project-specific

5.4 Mesoscale Analysis

Following the guidance in NYSDOT TEM Chapter 1.1 as revised in December 2012, a mesoscale air quality analysis was conducted of the roadways in the study area, including affected arterial roads. Emission burdens for carbon monoxide (CO), volatile organic compounds (VOC), nitrogen oxides (NOx), particulate matter (PM_{10} and $PM_{2.5}$) and Mobile Source Air Toxics (MSAT) were calculated based on link by link traffic data, as described in Section 5.2. On-road energy consumption and greenhouse gas emissions were also calculated with the emission model. The FHWA *Interim Guidance Update on Mobile Source Air Toxic (MSAT) Analysis in NEPA Documents*, most recently updated on December 6, 2012, was followed for project-level MSAT analyses.

Emissions of Polycyclic Organic Matter (POM) were not calculated, as they cannot be accurately modeled with MOVES2014a. This is because some of the species included in POM are only reported as zero emissions from the

MOVES2014a model[1]. As shown earlier in Figure 3, emissions of POM would show a similar trend as emissions of acrolein.

Emission burdens were calculated and compared for the following alternatives:

- No Build Alternative
- Build Alternative

Emission burdens were also calculated for the 50 mph conditions without the proposed project. Emission burdens were calculated for the ETC year (2020), ETC+10 (2030), and ETC+20 (2040). The results of the mesoscale analysis were used to determine the critical year for the particulate matter microscale analysis.

5.5 CO Microscale Analysis Screening

Following the guidance in NYSDOT TEM Chapter 1.1, a CO microscale screening analysis was conducted at the intersections impacted by the project (Table 3 and Table 4). Thirty-nine (39) intersections underwent screening. Following the referenced guidance, for those intersections that demonstrate a Build Level of Service (LOS) of C or better, no further analysis is required. Of the 39 intersections evaluated, 7 failed this initial screening, as they have LOS of D or below under Build conditions (Table 4). This was based on traffic analyses reflecting ETC, ETC+10 and ETC+20.

These 7 intersections were then screened according to the volume threshold screening, as detailed in Section I-3 of the NYSDOT TEM Chapter 1.1. The emission factors applied within this screening come from USEPA's MOVES2014a emission factor program and represent the year of ETC. The results of this screening are provided in Section 6.2.1.

5.6 Particulate Matter Microscale Analysis

5.6.1 Overview

The procedures prescribed in NYSDOT's TEM and USEPA's "*Transportation Conformity Guidance for Quantitative Hot-spot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas"* were utilized to conduct the $PM_{2.5}$/PM_{10} microscale air quality analysis. A microscale analysis consists of performing dispersion modeling of traffic-related air pollutant emissions for roadways determined to be of concern due to traffic volume changes or proximity of sensitive receptors. The microscale analysis was performed for the No Build Alternative, Build Alternative and 50 mph conditions without the

[1] Refer to page 6 of FHWA's Frequently Asked Questions (FAQ) in Conducting Quantitative MSAT Analysis: https://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/moves_msat_faq.pdf

proposed project. Following NYSDOT's TEM, microscale analyses were conducted for the year of expected highest emissions (critical year analysis), which, according to the results of the mesoscale analysis, is the project's ETC of 2020.

Refined modeling was conducted to estimate $PM_{2.5}$ and PM_{10} concentrations using USEPA's AERMOD dispersion model with emission factors by link from the MOVES2014a model runs.

Dispersion models use mathematical formulations to characterize the atmospheric processes that disperse pollutants emitted by emission sources, which in this case are the emissions generated by the vehicles moving and/or idling on the affected roadways and in the rest areas. AERMOD is currently USEPA's state-of-the-art model for predicting pollution concentrations from emission sources. Based on estimated emission rates and meteorological inputs, AERMOD was used to predict PM_{10} and $PM_{2.5}$ concentrations at the selected receptor locations.

The roadway links modeled, as detailed in Table 6, include Scajaquada Expressway, Parkside Avenue, and Humboldt Parkway.

Inputs to the modeling analysis consisted of detailed information about the affected roadways, including link lengths, road segment widths, vehicular volumes per hour, emission factors, receptor locations, and hourly meteorological data. Exhaust release heights of 2 feet above the ground were used to represent an average height of vehicle tailpipes in the project area.

5.6.2 Receptor Locations

The receptor locations were positioned according to criteria provided in NYSDOT's TEM and USEPA guidance. Receptors were placed in the residential areas adjacent to the intersection, as well as on the grounds of Medaille College and Delaware Park.

These receptors are expected to capture the highest concentrations from the emissions of vehicles traveling on the roadways. While the analyses estimated pollutant concentrations at all of the receptors shown under each scenario, only the maximum estimated concentration at any receptor is provided in the results.

5.6.3 Background Levels

Microscale modeling is used to predict concentrations resulting from emissions from motor vehicles using roadways immediately adjacent to the locations at which predictions are being made. A background level must be added to this value to account for pollution entering the area from other sources. The background level is the component of the total concentration not accounted for through the microscale modeling analysis. Unique $PM_{2.5}$ and PM_{10} background levels, based on the specific details of the applicable standards, and as recommended by USEPA, have been added to modeled results, as detailed in the following sections.

5.6.4 $PM_{2.5}$/PM_{10} Microscale Analysis

The $PM_{2.5}$ and PM_{10} microscale analysis was conducted following USEPA's *Transportation Conformity Guidance for Quantitative Hot-spot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas.* Based on the mesoscale emission analysis for years 2020, 2030, and 2040, year 2020 has the highest emissions. Hence, the $PM_{2.5}$ and PM_{10} microscale air quality analysis was performed for the year of ETC (2020).

As discussed in Section 5.3, $PM_{2.5}$ emissions account for tailpipe, tire wear, and brake wear emissions and PM_{10} emissions account for tailpipe, tire wear, brake wear and re-entrained dust emissions. On-road vehicle emissions were estimated using MOVES2014a. MOVES input files were provided by NYSDOT. MOVES input relies on link-specific data. The $PM_{2.5}$/PM_{10} emissions vary by time of day and time of year. Volume and speed data for each source were obtained from the traffic analysis as detailed in Section 5.2, for the AM peak, Midday, PM peak and overnight, using quarterly climate conditions, as provided by NYSDOT. For every source, a total of 16 emission factors in units of grams per mile were developed for the four time periods and four seasons.

The AERMOD dispersion model was used to determine $PM_{2.5}$ and PM_{10} levels. AERMOD is currently USEPA's state-of-the-art model for predicting pollution concentrations from all types of emission sources. Five years of meteorological data were input into the AERMOD program to calculate the annual and 24-hour particulate matter levels at the receptors analyzed. Five years of upper air and surface meteorological data were obtained from Buffalo Niagara International (BUF) Airport in Buffalo, NY.

Receptors were placed in a grid pattern around the study area sources according to criteria in NYSDOT's TEM and USEPA guidance (Figure 6).

Microscale modeling is used to predict concentrations resulting from emissions from motor vehicles using roadways immediately adjacent to the locations at which predictions are being made. A background level must be added to this value to account for pollution entering the area from other sources. The background level is the component of the total concentration not accounted for through the microscale modeling analysis.

USEPA's $PM_{2.5}$ design values for Erie, New York for the years 2013 to 2015 were used for the $PM_{2.5}$ background concentrations. As such, an annual $PM_{2.5}$ design value of 8.6 $\mu g/m^3$ was added to the annual modeled values, and a 24-

hour $PM_{2.5}$ background of 21.0 µg/m^3 was added to the 24-hour modeled values.

As there are no PM_{10} design values or recent monitored data in the Buffalo area, data from the closest active PM_{10} monitor in Erie, Pennsylvania were used for the PM_{10} background. Data at this location are considered representative of Buffalo as Erie, Pennsylvania is also located on the shores of Lake Erie, and the city lies approximately 80 miles west of Buffalo. As such, a PM_{10} 24-hour background of 37 µg/m^3 was added to the modeled values. This is the highest of the maximum concentrations measured at the Erie, Pennsylvania monitor from 2013 to 2015.

Figure 6 – Receptor Locations, Parkside Avenue and Scajaquada Expressway

Note: Receptor locations are represented by red crosses

6 Findings

6.1 Mesoscale Analysis

In accordance with NYSDOT guidance, a mesoscale analysis was conducted, using MOVES2014a, for the project's ETC (2020), ETC+10 (2030) and ETC+20 (2040), as described in Section 6.4. The mesoscale analysis was conducted for criteria pollutants, mobile source air toxics (MSATs), greenhouse gases (GHGs) and energy use.

Table 11 presents the vehicle miles traveled (VMT) and emission burdens of VOC, NOx, CO, PM_{10} and $PM_{2.5}$ under the No Build and Build Alternatives. As shown in the table, in all analysis years, the VMT is slightly higher (by 1.2%) under the Build Alternative, when compared to that under the No Build. The emission burdens of VOCs are slightly higher (by 0.1%) under the Build Alternative, when compared to that under the No Build. Emission burdens of all other pollutants are slightly lower (by -0.1% to -2.2%) under the Build Alternative, when compared to that under the No Build. These lower emissions, when considering the higher VMT under the Build Alternative, are mainly due to emission characteristics of these pollutants versus vehicle speeds in the MOVES emissions model.

Table 12 presents the emission burdens of MSATs under the No Build and Build Alternatives. As shown in the table, in all analysis years, MSATs are lower (by -1.7% to -5.7%) under the Build Alternative, when compared to that under the No Build. These lower emissions of MSATs, when considering the higher VMT under the Build Alternative, are mainly due to the emission characteristics of MSATs versus vehicle speeds in the MOVES emission model.

Table 13 presents the emission burdens of GHGs in terms of CO_2e, as well as differences in energy consumption, under the No Build and Build Alternatives. As shown in the table, in all analysis years, both CO_2e and energy are lower (by -0.4% to -1.3%) under the Build Alternative, when compared to that under the No Build. These lower values of CO_2e and energy use, when considering the higher VMT under the Build Alternative, are mainly due to the emission characteristics of CO_2e and energy versus vehicle speeds in the MOVES emission model.

For all criteria pollutants, MSATs, CO_2e and energy, the highest burdens are in the ETC (2020), and the lowest are in ETC+20 (2040).

Table 11 – Mesoscale Emission Burdens (tons/year)

Pollutant	2020			2030			2040		
	No Build	Build	% Difference	No Build	Build	% Difference	No Build	Build	% Difference
VMT (miles/year)	*43,334,342*	*43,863,753*	*1.2%*	*44,244,215*	*44,783,496*	*1.2%*	*45,166,927*	*45,708,878*	*1.2%*
VOC	78.85	78.93	0.1%	52.18	52.21	0.1%	39.93	39.95	0.1%
NOx	303.62	303.06	-0.2%	282.29	282.00	-0.1%	255.67	255.54	-0.1%
CO	290.38	284.78	-1.9%	210.34	206.95	-1.6%	182.74	179.94	-1.5%
PM_{10}	7.45	7.44	-0.1%	5.50	5.46	-0.8%	3.73	3.65	-2.2%
$PM_{2.5}$	4.59	4.55	-1.0%	2.72	2.69	-1.0%	1.00	0.98	-2.0%

Table 12 – Mobile Source Air Toxic (MSAT) Emission Burdens (tons/year)

Pollutant	2020			2030			2040		
	No Build	Build	% Difference	No Build	Build	% Difference	No Build	Build	% Difference
VMT (miles/year)	*43,334,342*	*43,863,753*	*1.2%*	*44,244,215*	*44,783,496*	*1.2%*	*45,166,927*	*45,708,878*	*1.2%*
Acrolein	0.00735	0.00720	-2.0%	0.00405	0.00387	-4.4%	0.00206	0.00200	-2.7%
Benzene	0.06987	0.06815	-2.5%	0.03314	0.03184	-3.9%	0.02415	0.02316	-4.1%
1,3 Butadiene	0.00584	0.00574	-1.7%	0.00134	0.00126	-5.7%	0.00014	0.00013	-2.4%
Diesel PM	0.55498	0.53408	-3.8%	0.19281	0.18590	-3.6%	0.07899	0.07743	-2.0%
Formaldehyde	0.11391	0.11186	-1.8%	0.06919	0.06680	-3.5%	0.04605	0.04481	-2.7%
Naphthalene	0.01208	0.01184	-1.9%	0.00661	0.00634	-4.1%	0.00375	0.00364	-2.9%

*As described in Section 6.4, emissions of POM cannot be accurately calculated by MOVES2014a but would show a similar trend as emissions of acrolein

Table 13 – Energy and GHG Burdens

Pollutant	2020			2030			2040		
	No Build	Build	% Difference	No Build	Build	% Difference	No Build	Build	% Difference
VMT (miles/year)	*43,334,342*	*43,863,753*	*1.2%*	*44,244,215*	*44,783,496*	*1.2%*	*45,166,927*	*45,708,878*	*1.2%*
CO_2e (tons/year)	34,664	34,535	-0.4%	29,322	29,085	-0.8%	27,993	27,655	-1.2%
Energy (MBTU/year)	399,334	397,782	-0.4%	334,747	331,922	-0.8%	317,708	313,691	-1.3%

MBTU = Million British Thermal Units

6.2 Microscale Analysis

Following NYSDOT's TEM, a microscale analysis was conducted for the year of expected highest emissions, which, according to the results of the mesoscale analysis, is 2020 (ETC). If the microscale analysis for the ETC does not indicate an exceedance of the applicable NAAQS, then no exceedances are expected in other years.

6.2.1 Carbon Monoxide

Seven intersections failed the initial screening analysis, as they have a LOS of D or worse under the Build Alternative. A volume threshold screening was therefore conducted, and the results were compared to the thresholds in Table 3C of Section I-3 of the NYSDOT TEM Chapter 1.1.

The emission factors applied within this screening are from USEPA's MOVES2014a model and represent the year of ETC. CO emission factors were generated for both idle and the average speed within the project corridor, 30 mph. The resulting emission factors are as follows:

- Idle = 9.9 grams per hour
- 30 mph = 2.6 grams per mile

Upon comparison to Table 3C in the TEM, when applying the above emission factors, intersections in the project would screen out if they have approach volumes of less than 4,000 at any approach.

As shown in Table 4, none of the intersections have volumes close to 4,000 at any approach (they are all below 3,000). As such, none of the intersections in the project area meet the criteria that would warrant a microscale analysis.

The project would not increase traffic volumes or change other existing conditions to such a degree as to jeopardize attainment of the NAAQS for CO.

6.2.2 Particulate Matter

The $PM_{2.5}$ and PM_{10} maximum concentrations (including background) are summarized in Table 14, Table 15, and Table 16. These concentrations are given for 2020 (ETC), which was determined to be the critical year for the analysis based on the mesoscale analysis results. The result of this analysis is that no exceedances of the PM_{10} and $PM_{2.5}$ NAAQS were predicted under either alternative. Contour maps of the results are presented in Figure 7 through Figure 12.

Table 14 – Predicted 24-hour PM_{10} Maximum Concentrations – 2020

Alternative	Background Concentration (ug/m^3)	Modeled Concentration (ug/m^3)	Total Concentration* (ug/m^3)
No Build	37	17.2	54.2
Build		15.9	52.9

Notes: *Total concentrations = modeled results + 24-hour PM_{10} background
24-hour PM_{10} standard = 150 ug/m^3
Abbreviation: ug/m^3 = micrograms per cubic meter

Table 15 – Predicted 24-hour $PM_{2.5}$ Maximum Concentrations – 2020

Alternative	Background Concentration (ug/m^3)	Modeled Concentration (ug/m^3)	Total Concentration* (ug/m^3)
No Build	21	1.0	22.0
Build		0.8	21.8

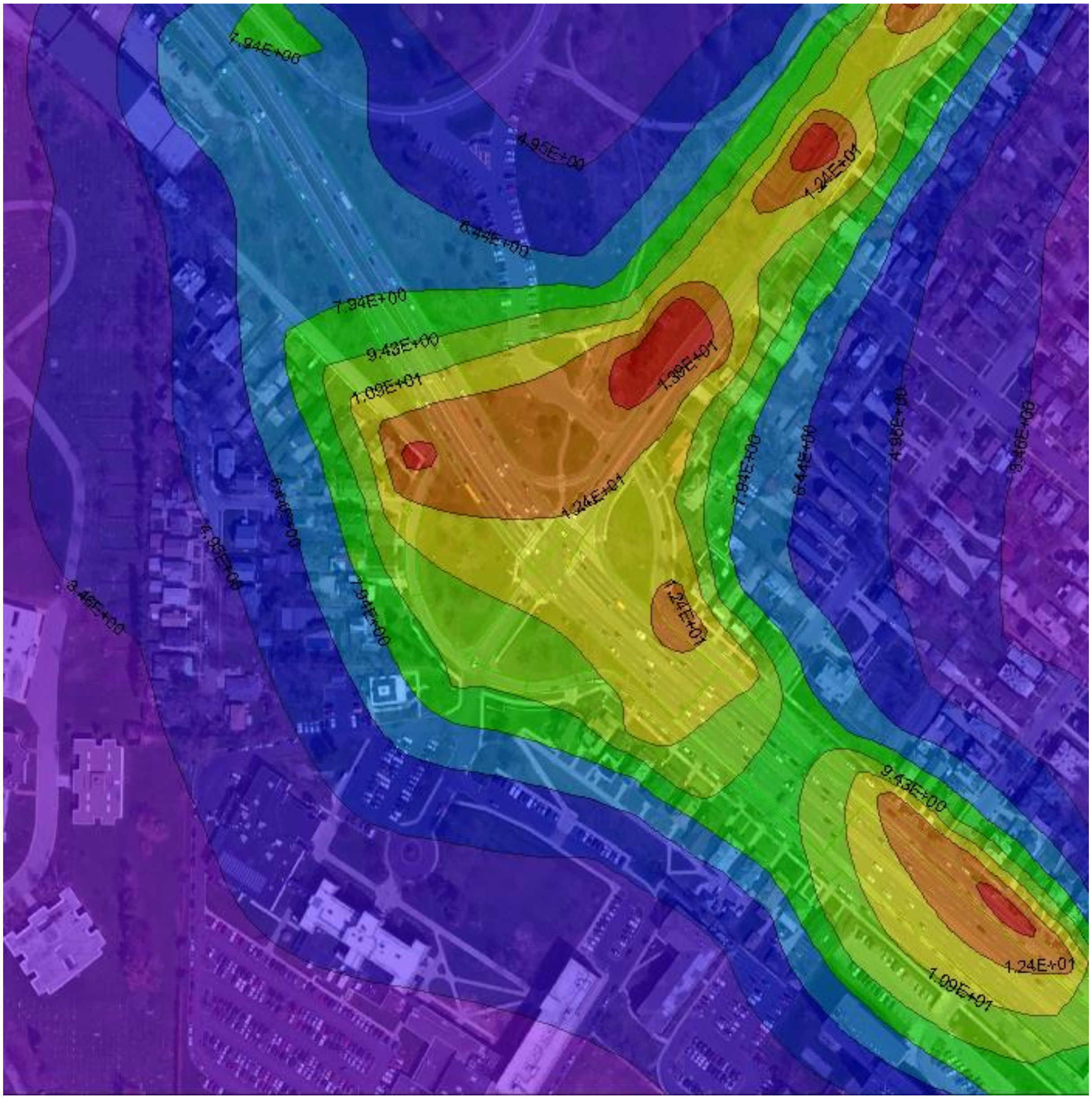
Notes: *Total concentrations = modeled results + 24-hour $PM_{2.5}$ background
24-hour $PM_{2.5}$ standard = 35 ug/m^3
Abbreviation: ug/m^3 = micrograms per cubic meter

Table 16 – Predicted Annual $PM_{2.5}$ Maximum Concentrations – 2020

Alternative	Background Concentration (ug/m^3)	Modeled Concentration (ug/m^3)	Total Concentration* (ug/m^3)
No Build	8.6	0.3	8.9
Build		0.2	8.8

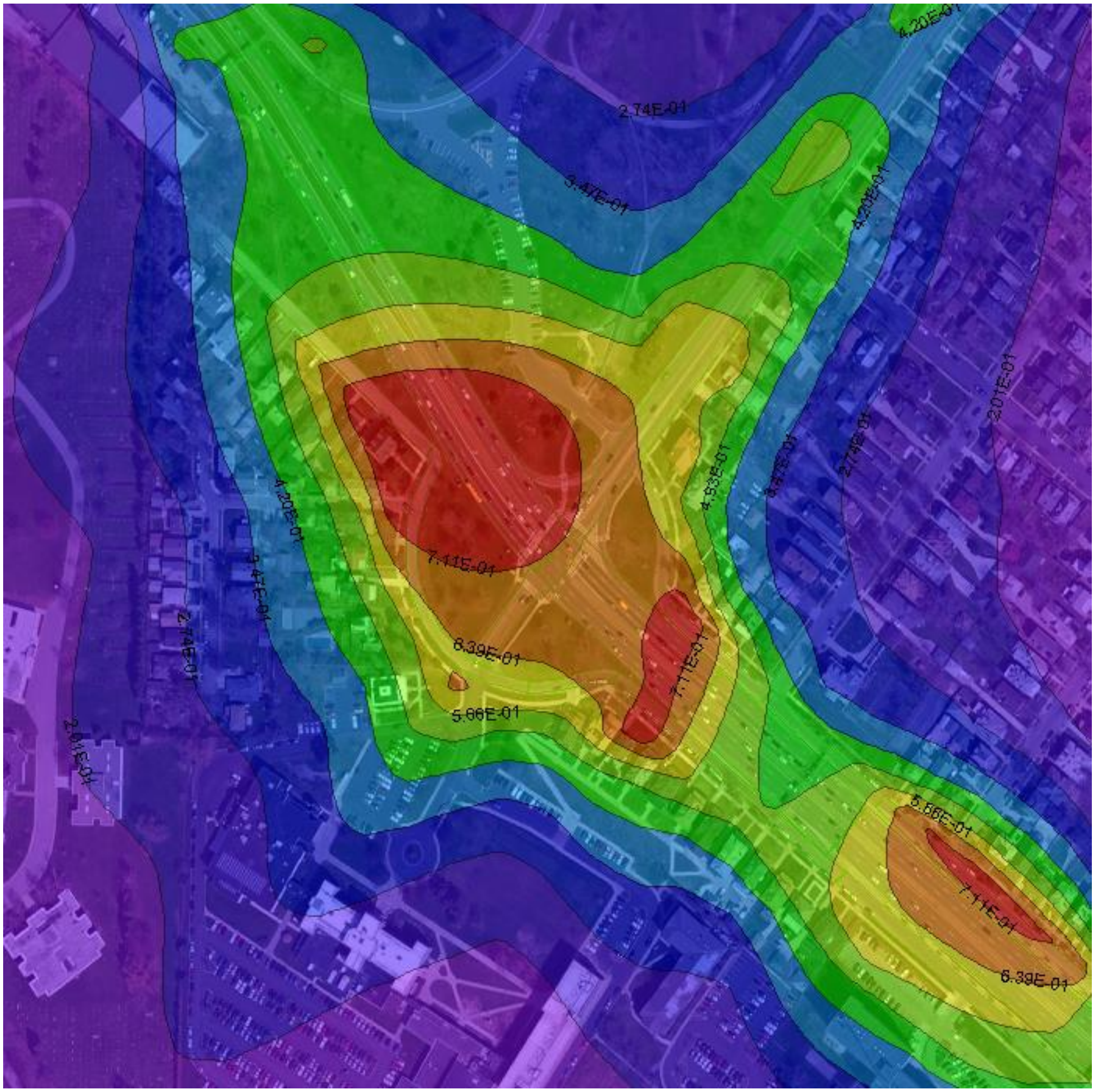
Notes: *Total concentrations = modeled results + Annual $PM_{2.5}$ background
Annual $PM_{2.5}$ standard = 12 ug/m^3
Abbreviation: ug/m^3 = micrograms per cubic meter

Figure 7 – No-Build Alternative 24-hour PM_{10} Contours – 2020 (ug/m^3)



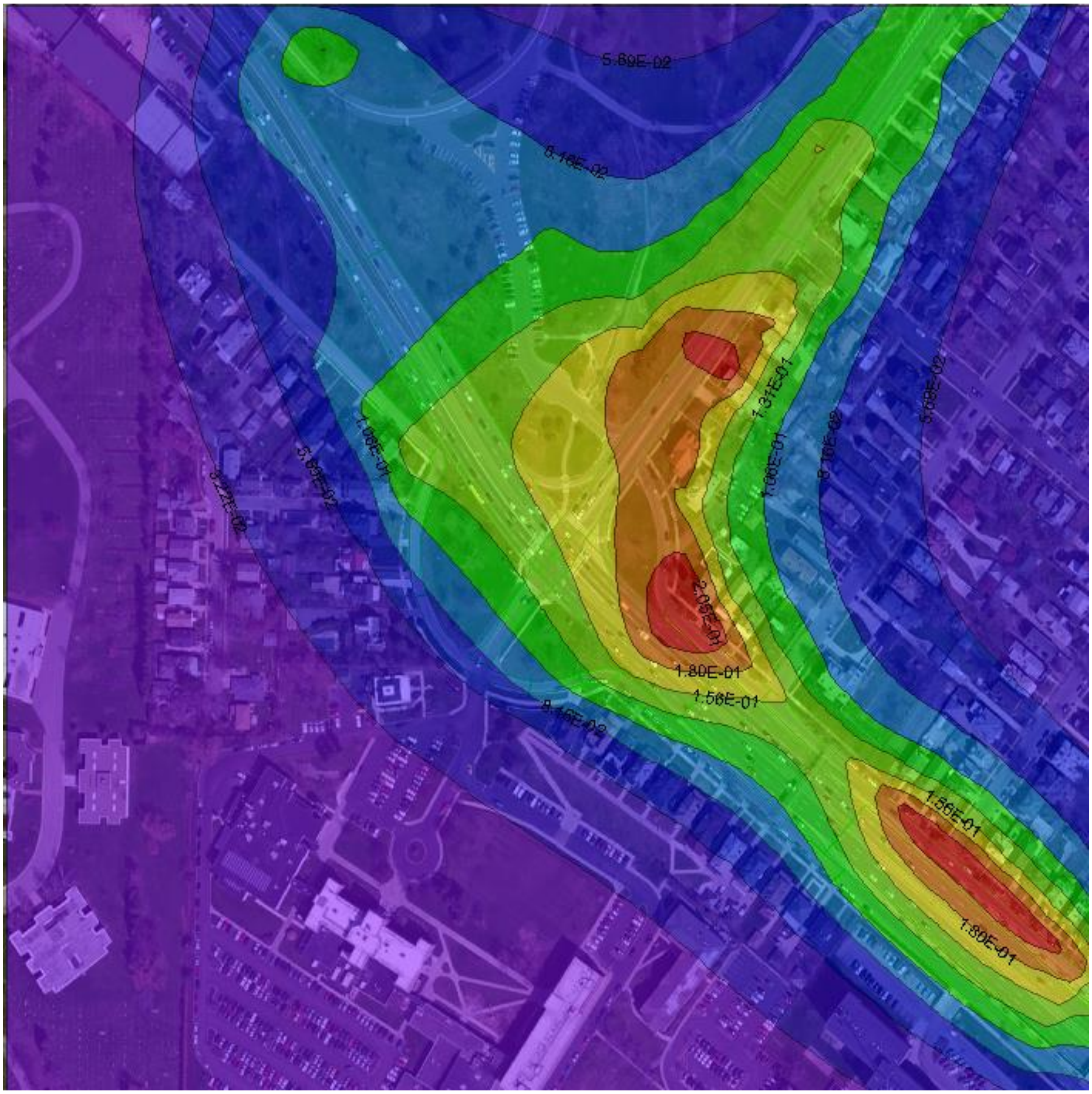
Note: contours do not include background concentrations.

Figure 8 – No-Build Alternative 24-hour $PM_{2.5}$ Contours – 2020 (ug/m^3)



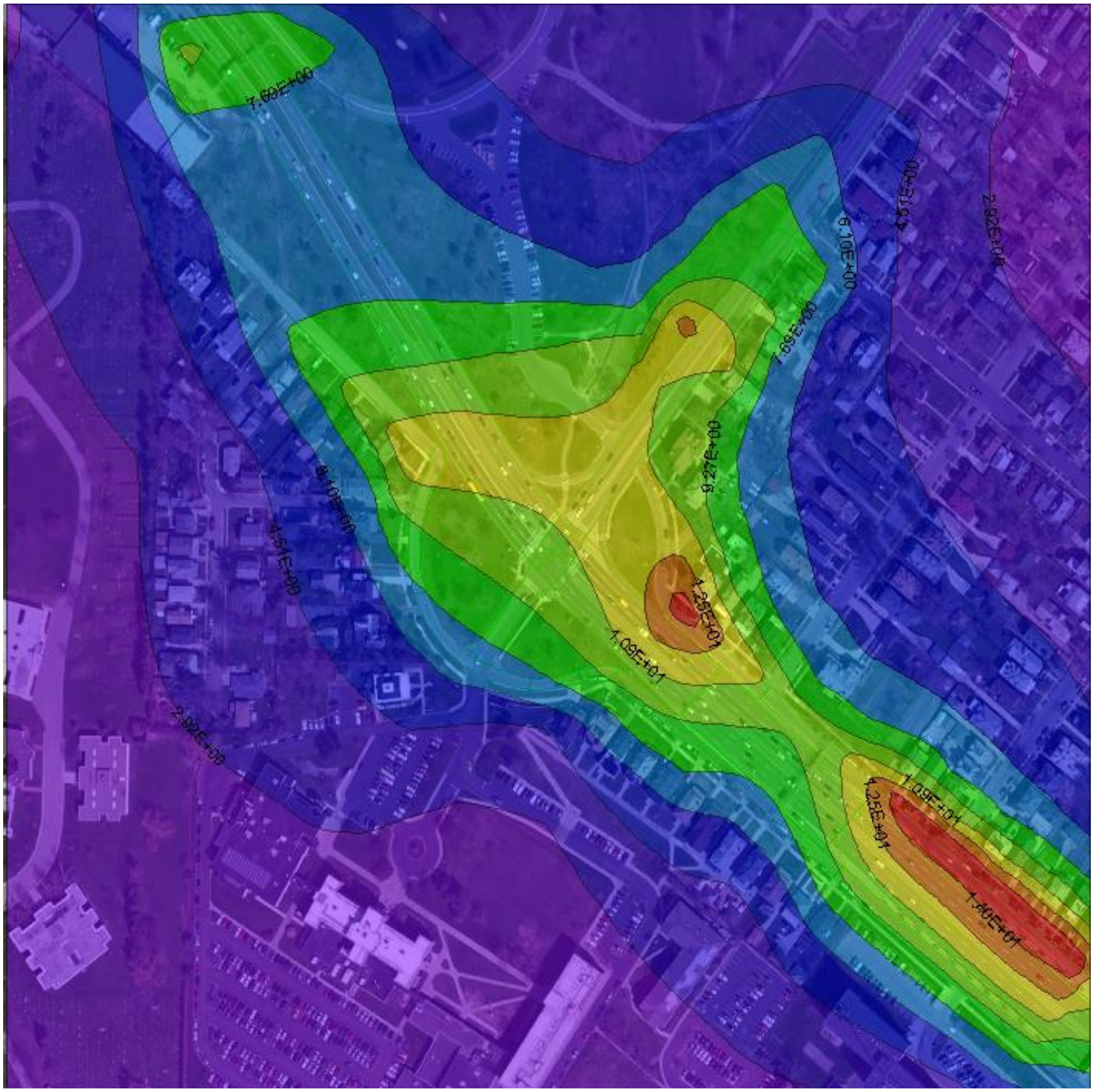
Note: contours do not include background concentrations.

Figure 9 – No-Build Alternative Annual $PM_{2.5}$ Contours – 2020 (ug/m^3)



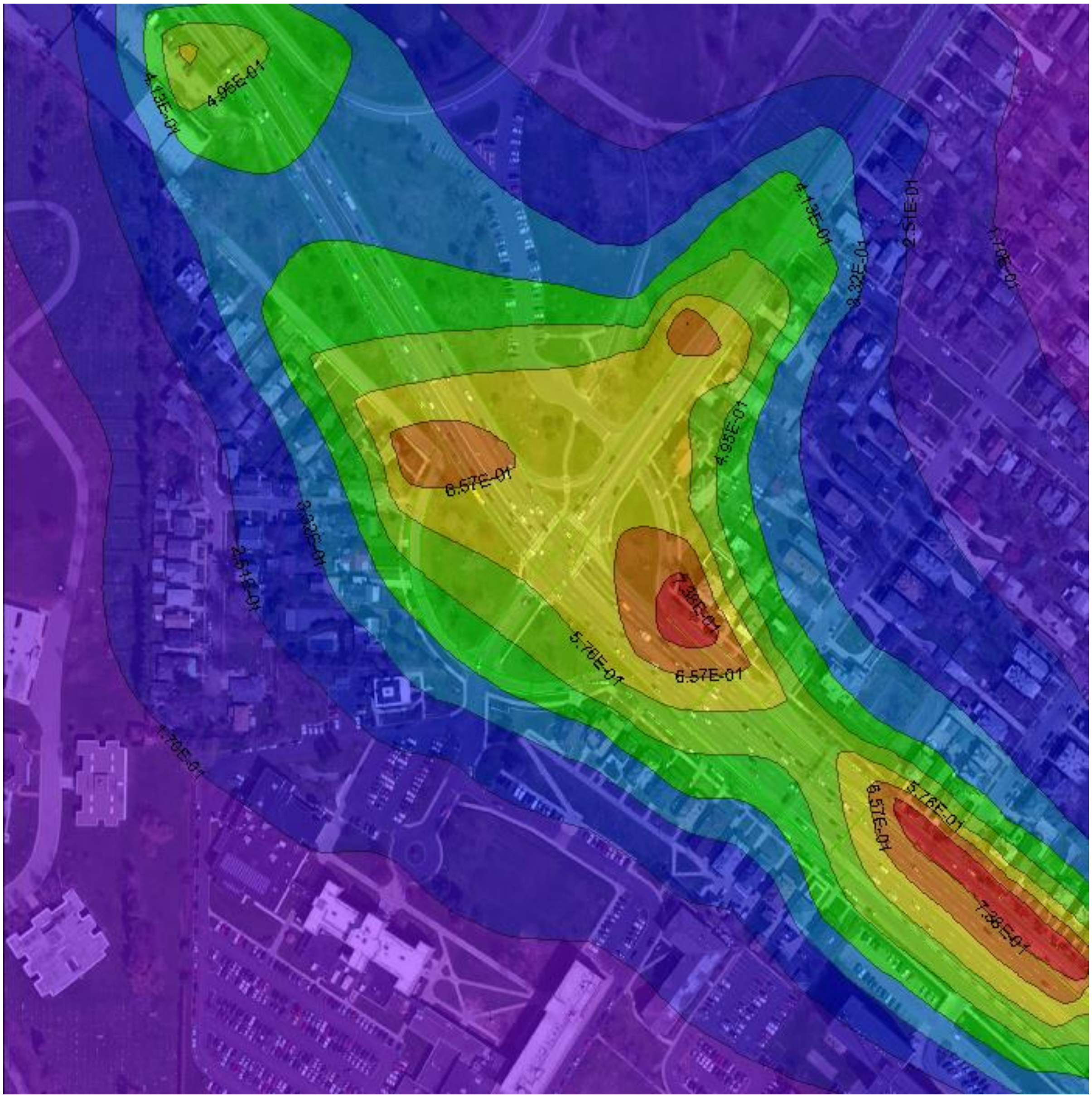
Note: contours do not include background concentrations.

Figure 10 – Build Alternative 24-hour PM_{10} Contours – 2020 (ug/m^3)



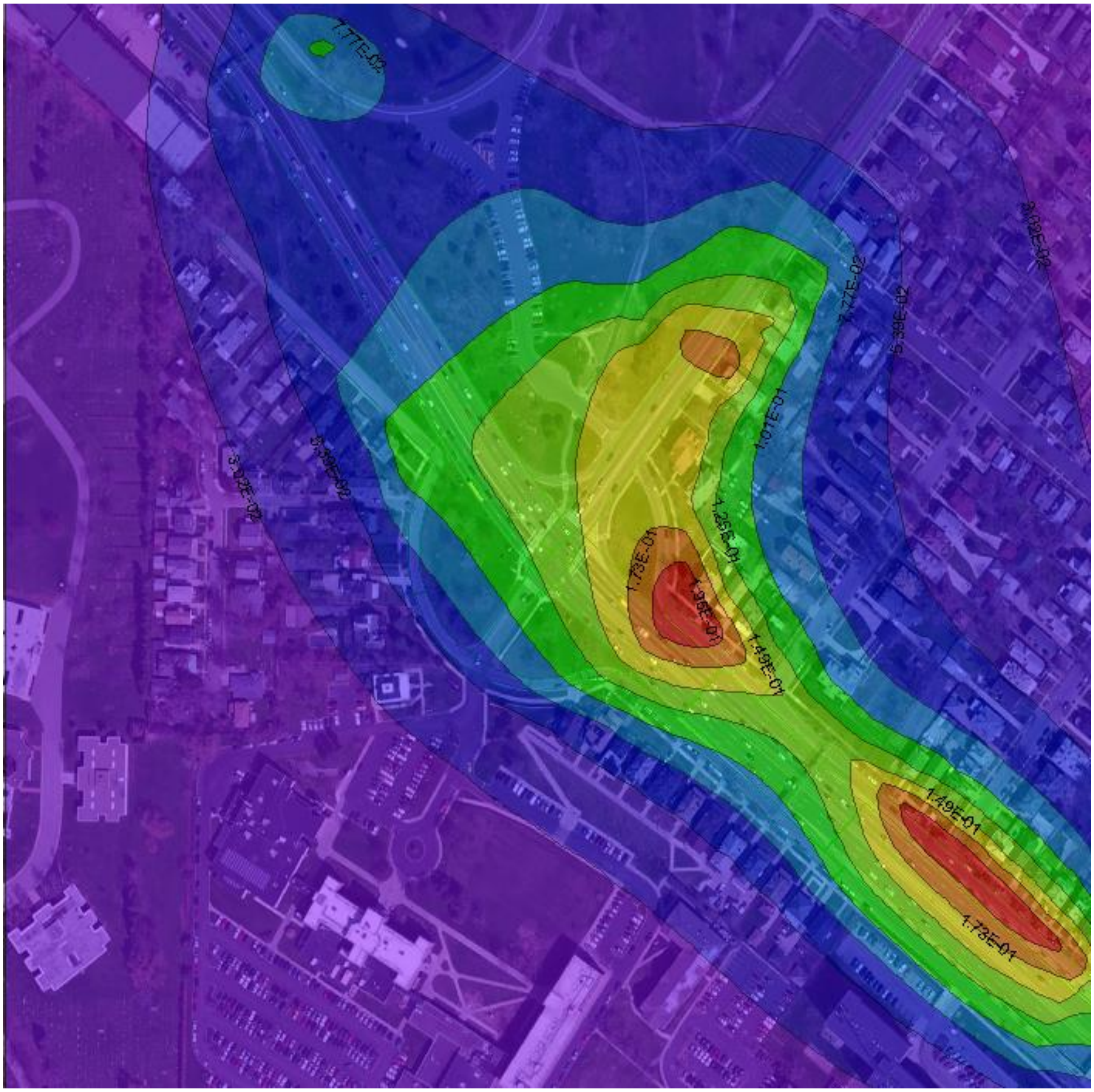
Note: contours do not include background concentrations.

Figure 11 – Build Alternative 24-hour $PM_{2.5}$ Contours – 2020 (ug/m^3)



Note: contours do not include background concentrations.

Figure 12 – Build Alternative Annual $PM_{2.5}$ Contours – 2020 (ug/m^3)



Note: contours do not include background concentrations.

6.3 50 mph Conditions without Project

The 50 mph conditions without the proposed project were evaluated to address cumulative effects. The 50 mph conditions reflect data that were collected before the speed limit was changed to 30 mph, lanes were narrowed, and stop signs were installed on ramp approaches. These changes resulted in an approximate diversion of 20% of the traffic volume from the 50 mph conditions (see Chapter 3 of this DEIS).

As shown in Table 17, VMT for the 50 mph conditions is approximately 20% higher in the project study area than that for the No Build and Build Alternatives. This table also presents the emission burdens of the 50 mph conditions in ETC (2020), ETC+10 (2030) and ETC+20 (2040).

Table 17 – Mesoscale Emission Burdens - 50 mph Conditions without Project (tons/year)

Pollutant	2020	2030	2040
VMT (miles/year)	*54,186,289*	*55,278,368*	*56,361,650*
VOC	82.15	54.33	41.62
NOx	309.23	285.07	257.48
CO	335.82	236.98	203.92
PM_{10}	8.08	6.11	4.30
$PM_{2.5}$	4.86	2.88	1.11

Table 18 presents the MSAT emission burdens under the 50 mph conditions without the project, and Table 19 presents the CO_2e and energy consumption. For all criteria pollutants, MSATs, CO_2e and energy, the highest burdens are in the ETC (2020), and the lowest are in ETC+20 (2040).

Table 18 – Mobile Source Air Toxic (MSAT) Emission Burdens – 50 mph Conditions without Project (tons/year)

Pollutant	2020	2030	2040
VMT (miles/year)	*54,186,289*	*55,278,368*	*56,361,650*
Acrolein	0.00879	0.00489	0.00248
Benzene	0.08597	0.04123	0.02983
1,3 Butadiene	0.00704	0.00163	0.00016
Diesel PM	0.65903	0.23277	0.09556
Formaldehyde	0.13642	0.08365	0.05543
Naphthalene	0.01450	0.00801	0.00453

*As described in Section 6.4, emissions of POM cannot be accurately calculated by MOVES2014a but would show a similar trend as emissions of acrolein

Table 19 – Energy and GHG Burdens - 50 mph Conditions without Project

Pollutant	2020	2030	2040
VMT (miles/year)	54,186,289	55,278,368	56,361,650
CO_2e (tons/year)	39,647	33,411	31,867
Energy (MBTU/year)	458,191	382,994	363,392

MBTU = Million British Thermal Units

Table 20, Table 21, and Table 22 present the results of the particulate matter microscale analysis for the 50 mph conditions without the project in 2020 (ETC). As shown in these tables, no exceedances of the NAAQS were predicted. Contour maps of the results are presented in Figure 13 through Figure 15.

Table 20 – Predicted 24-hour PM_{10} Maximum Concentrations, 50 mph Conditions without Project– 2020

Background Concentration (ug/m^3)	Modeled Concentration (ug/m^3)	Total Concentration* (ug/m^3)
37	19.9	56.9

Notes: *Total concentrations = modeled results + 24-hour PM_{10} background
24-hour PM_{10} standard = 150 ug/m^3
Abbreviation: ug/m^3 = micrograms per cubic meter

Table 21 – Predicted 24-hour $PM_{2.5}$ Maximum Concentrations, 50 mph Conditions without Project– 2020

Background Concentration (ug/m^3)	Modeled Concentration (ug/m^3)	Total Concentration* (ug/m^3)
21	1.0	22.0

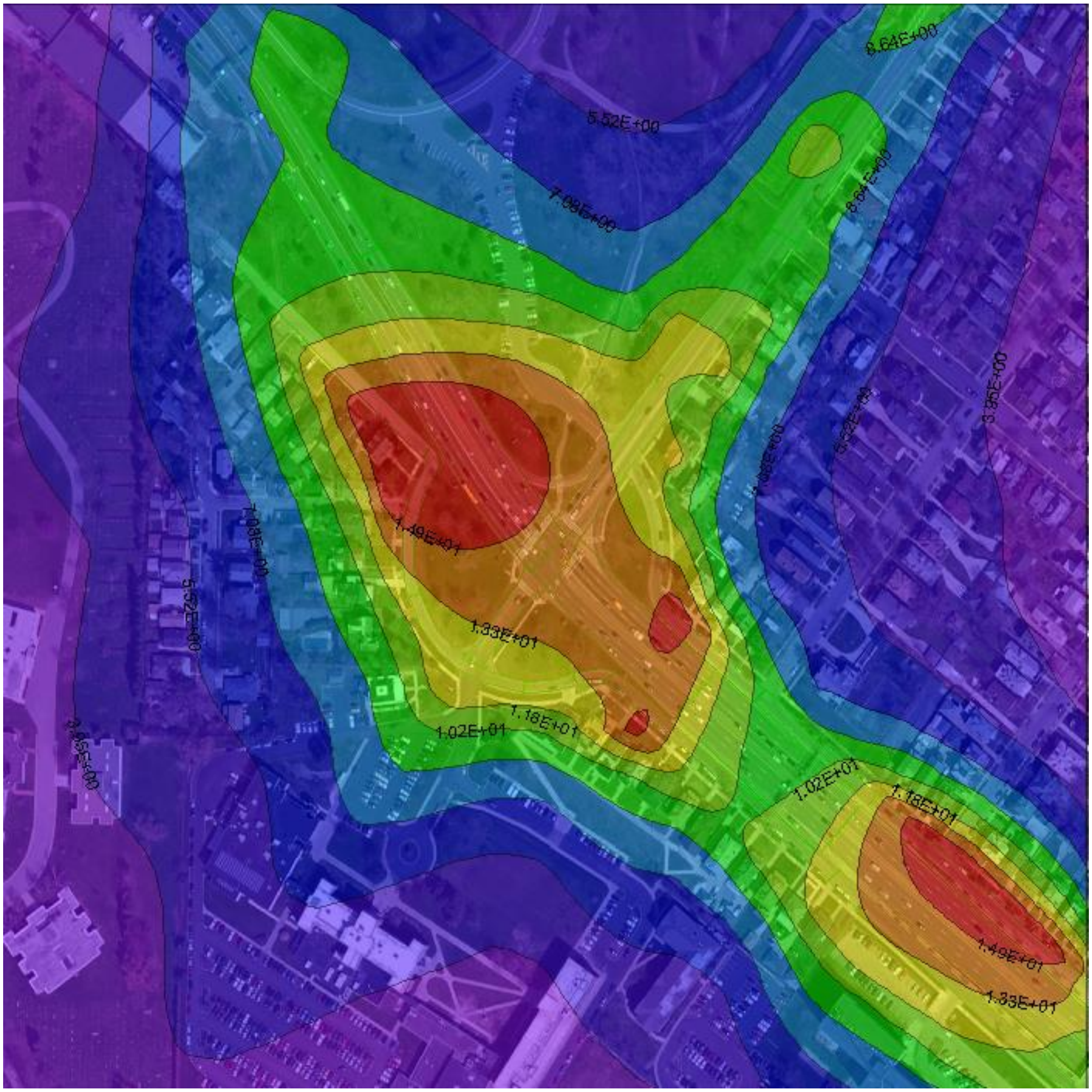
Notes: *Total concentrations = modeled results + 24-hour $PM_{2.5}$ background
24-hour $PM_{2.5}$ standard = 35 ug/m^3
Abbreviation: ug/m^3 = micrograms per cubic meter

Table 22 – Predicted Annual $PM_{2.5}$ Maximum Concentrations, 50 mph Conditions without Project– 2020

Background Concentration (ug/m^3)	Modeled Concentration (ug/m^3)	Total Concentration* (ug/m^3)
8.6	0.2	8.8

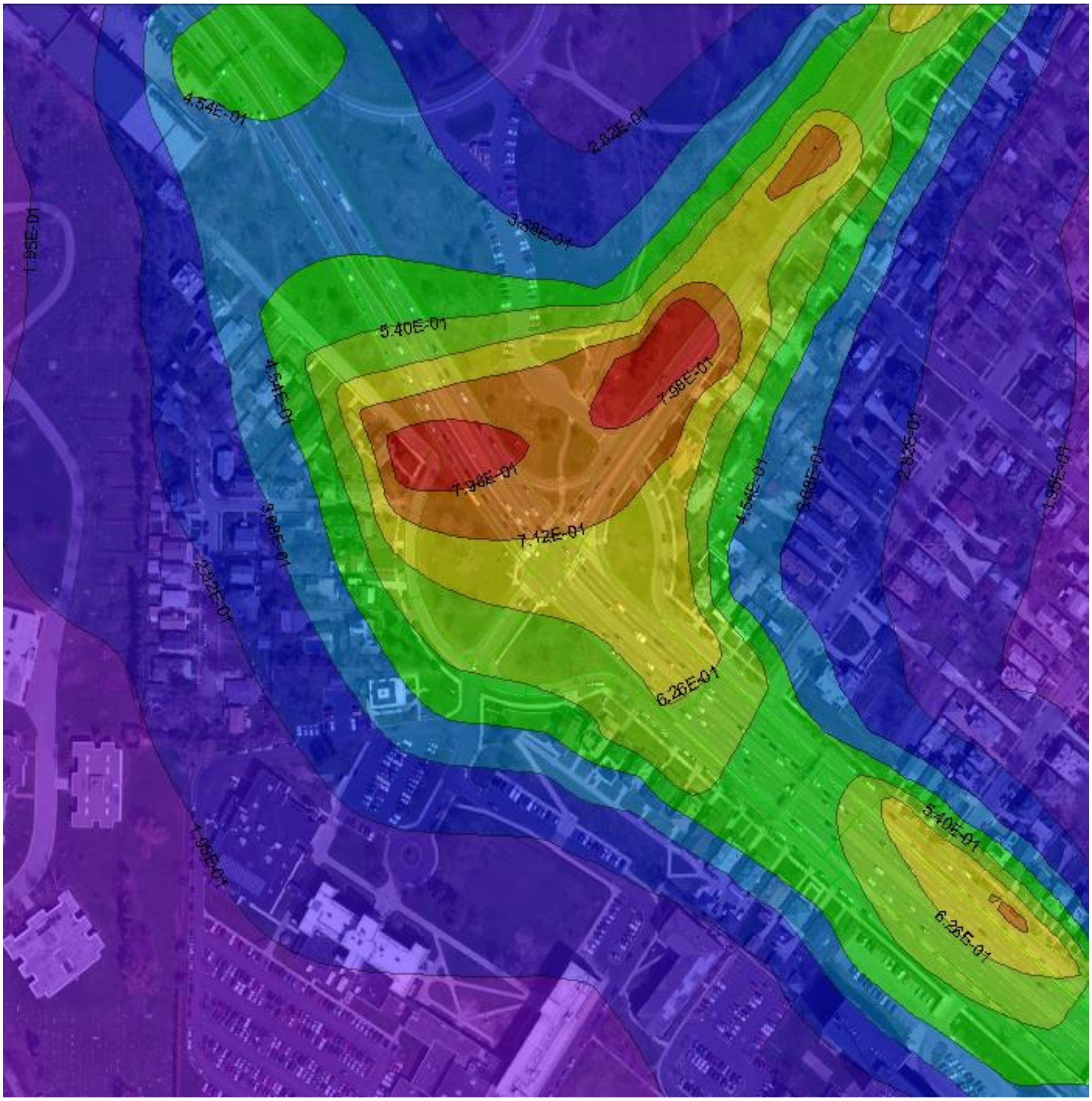
Notes: *Total concentrations = modeled results + Annual $PM_{2.5}$ background
Annual $PM_{2.5}$ standard = 12 ug/m^3
Abbreviation: ug/m^3 = micrograms per cubic meter

Figure 13 – 50 mph Conditions without Project 24-hour PM_{10} Contours – 2020 (ug/m^3)



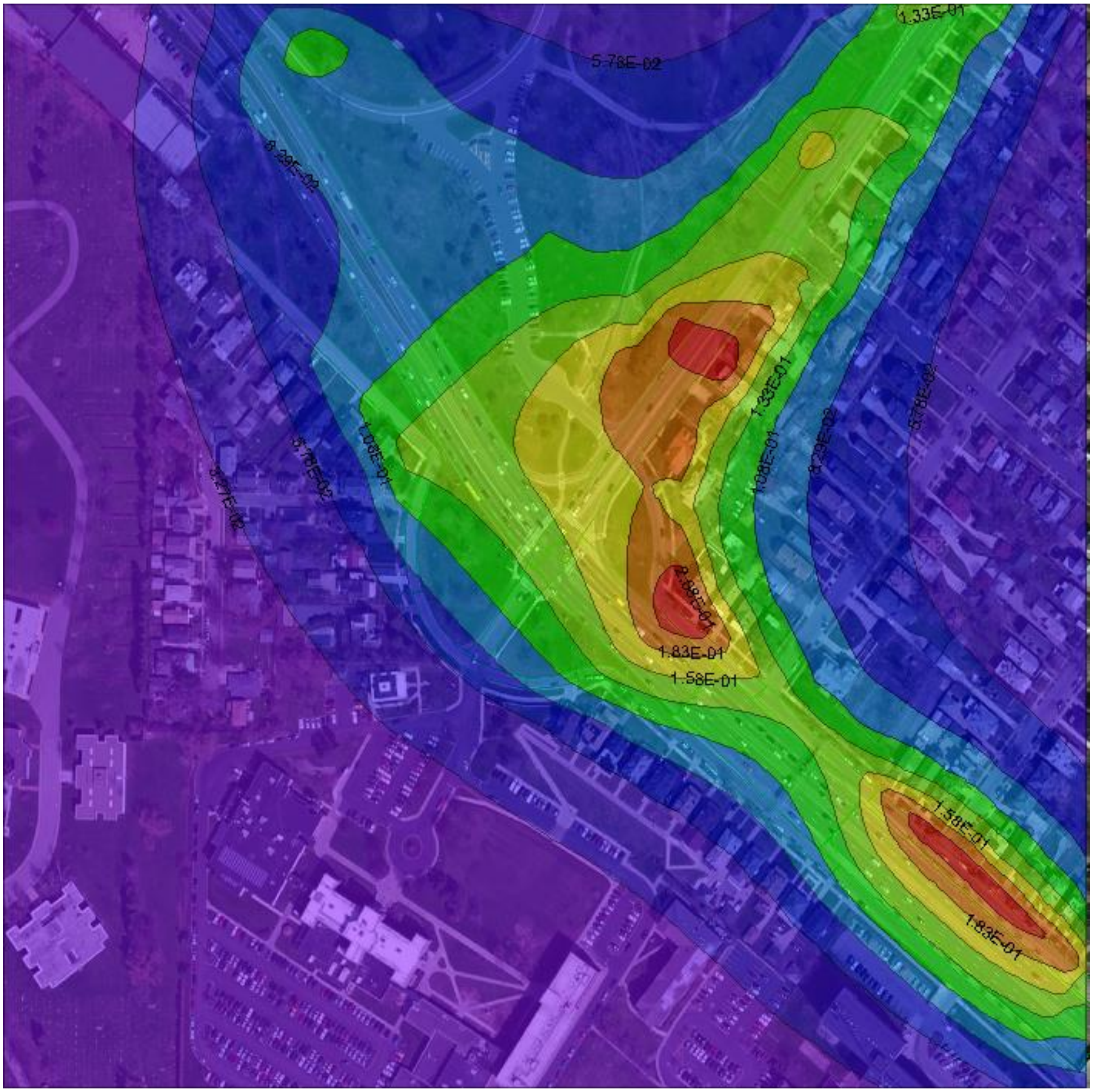
Note: contours do not include background concentrations.

Figure 14 – 50 mph Conditions without Project 24-hour $PM_{2.5}$ Contours – 2020 (ug/m^3)



Note: contours do not include background concentrations.

Figure 15 – 50 mph Conditions without Project Annual $PM_{2.5}$ Contours – 2020 (ug/m^3)



Note: contours do not include background concentrations.

7 References

Council on Environmental Quality (CEQ), *Final Guidance on Greenhouse Gases and Climate Change.* August 2016. https://www.whitehouse.gov/sites/whitehouse.gov/files/documents/nepa_final_ghg_guidance.pdf

Federal Highway Administration (FHWA), *Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA*. December 2012. https://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/aqintguidmem.cfm

Federal Highway Administration (FHWA), *Frequently Asked Questions (FAQ), Conducting Quantitative MSAT Analysis for FHWA NEPA Documents*. https://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/moves_msat_faq.pdf. Accessed September 2016.

New York State Department of Environmental Conservation (NYSDEC). 2014. *Air Quality Monitoring Data* http://www.dec.ny.gov/chemical/8406.html. Accessed August, 2016.

New York State Department of Environmental Conservation (NYSDEC). 2015. *National Ambient Air Quality Standards,* http://www.dec.ny.gov/chemical/8542.html. Accessed August, 2016.

New York State Department of Transportation (NYSDOT). *Draft Design Report / Environmental Impact Statement*. September 2016.

New York State Department of Transportation (NYSDOT). 2001. *The Environmental Manual* (TEM). (Formerly known as Environmental Procedures Manual (EPM). Chapter 1.1 - Air Quality. Updated December 2012.

United States Environmental Protection Agency (EPA). *2015 Design Value Reports*.https://www.epa.gov/air-trends/air-quality-design-values#report. Accessed August, 2016.

United States Environmental Protection Agency (EPA). *AirData*. https://www.epa.gov/outdoor-air-quality-data. Accessed August, 2016.

United States Environmental Protection Agency (EPA). *Air Trends – Carbon Monoxide*.https://www.epa.gov/air-trends/carbon-monoxide-trends#conat. Accessed August, 2016.

United States Environmental Protection Agency (EPA), Greenhouse Gas and Energy Consumption Rates for On-road Vehicles, Updates for MOVES2014. October 2015. https://www3.epa.gov/otaq/models/moves/documents/420r15003.pdf

United States Environmental Protection Agency (EPA), *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in* $PM_{2.5}$ *and* PM_{10} *Nonattainment and Maintenance Areas*. November 2015. https://www.epa.gov/state-and-local-transportation/project-level-conformity-and-hot-spot-analyses#pmguidance.

United States Environmental Protection Agency (EPA). *Understanding Global Warming Potentials*. https://www.epa.gov/ghgemissions/understanding-global-warming-potentials Accessed September 2016.

United States Environmental Protection Agency (EPA). *User's Guide for the AMS/EPA Regulatory Model –AERMOD*. Report No EPA-454/B-03-001. September 2004. https://www3.epa.gov/scram001/7thconf/aermod/aermodugb.pdf.

8 MOVES2014a Model Files

Provided electronically.

9 AERMOD Model Files

Provided electronically.